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(54) Title: TRANSPORT MULTIPLEXER MANAGEMENT AND CONTROL

(57) Abstract: A feature-rich transport multiplexer and a number of associated methods, systems, subsystems, software features, graphical user interfaces and control systems are disclosed. The disclosure includes GUI's that enable operators to easily monitor and manipulate content streams flowing through a transport multiplexer in real time. The disclosed interfaces include screens that supply operators with identity, structure, configuration, bandwidth utilization and/or status information for system hardware and software. The disclosed features also provide computer assisted routing configuration for present and future routing events through simple manipulation, such as drag and drop operations, of graphical objects. Routing control is further simplified by permitting operators to configure routing control of individual content stream components as well as groups of such components simultaneously. Further flexibility is permitted by predetermination of future routing events, thereby enabling the automatic execution of configuration changes at a future time. Various types of content, such as video, audio, IP data can be manipulated to achieve various results such as one or more multiplexed MPEG data streams.



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TRANSPORT MULTIPLEXER MANAGEMENT AND CONTROL

CROSS REFERENCE TO RELATED CASES

[0001] This application claims the benefit under 35 U.S.C. 119(e) of co-pending U.S. Provisional Application Nos. 60/285,188 filed April 20, 2001 and entitled "Broadband Bandwidth Management, Device Management and Multi-Media Control System"; and 60/285,153 filed April 20, 2001 and entitled "Data Insertion, Transport, Grooming, Aliasing, Routing, and Multiplexing of MPEG 2 Data Streams", which Provisional Applications are hereby incorporated by reference.

[0002] This application is related to co-pending U.S. Patent Application Serial No. __/__, filed April 16, 2002 (based on provisional application no. 60/322,063 filed September 13, 2001) and entitled "High Speed Serial Data Transport Between Communications Hardware Modules," which Application is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0003] The present invention is directed to systems, processes, methodologies, apparatus and related software to manage and control broadband communications hardware. More particularly, the invention relates to improved up management and control of content streams routed through a broadband media router. Accordingly, the general objects of the invention are to provide novel systems, methods, apparatus and software of such character.

2. Description of the Related Art

[0004] Broadband media convergence between video, audio and data in recent years has created a chaotic environment of different standards and legacy communications technologies. Nonetheless, the relationship between physical and logical resources in such systems needs to be manipulated and communicated between broadband hardware, its control system and its operators. This has, in the past, been accomplished with a complex of dedicated management and control computers, each of which was responsible for administration of a specific piece of communications hardware. While modern communications hardware personnel, such as cable operators and television programmers, have used such systems in the past, such systems use great numbers of diverse equipment to control the system. These control systems have been centrally located in close proximity to each other and to the communications hardware being managed. For these and other reasons, conventional solutions to the need for control and management of broadband communications hardware have proven to be cumbersome, inflexible, inefficient and expensive to purchase and operate.

[0005] An additional problem with conventional broadband communications hardware is their inability to conveniently provide operators with information regarding the system hardware and software. This creates many inefficiencies in operation of such equipment. For example, troubleshooting system errors is currently a difficult and expensive process because system operators must physically inspect the broadband communications hardware in order to determine the system hardware utilized and its operational status. In particular, troubleshooting system difficulties may entail operator inspections of a communications hardware rack to determine if all of the communications hardware has been plugged-in, turned on, connected to the desire content streams and/or operated in a particular way.

[0006] There is, accordingly, a need in the art for novel methods, systems and apparatus that enable communications hardware personnel, such as cable operators and television programmers, to manage and control complete broadband media router systems with a single computer. Such methods and apparatus should be capable of remotely

monitoring and controlling such systems over a network. Ideally, control would be achieved with java-based system that could be uploaded to a remote personal computer using a browser during a set-up phase and subsequently run on the remote computer as a java program. In order to provide maximum flexibility at minimal cost, such a system would communicate via the network using a common browser and a widely recognized communications protocol such as SNMP.

[0007] There is a further a need in the art for novel methods, systems and apparatus that can provide operators with information regarding system hardware and software. Such methods and apparatus facilitate troubleshooting of system errors by avoiding the need to physically inspect broadband communications hardware in order to determine the system hardware utilized and its operational status. Indeed, such methods and apparatus of managing and controlling communications hardware should be capable of providing highly stable control over broadband media routers so that such troubleshooting can be minimized, if not eliminated altogether.

SUMMARY OF THE INVENTION

[0008] The present invention satisfies the above-stated needs and overcomes the above-stated and other deficiencies of the related art by providing methods, systems and apparatus that enable communications hardware personnel to manage and control complete broadband media router systems with a single computer. Such methods and apparatus in accordance with the invention are capable of remotely monitoring and controlling such systems over a communications network such as an Ethernet network. Management of a broadband media router, is preferably achieved with a java-based system that has been uploaded to a remote personal computer via the network during a set-up phase and then run on the remote computer in order to remotely manage the hardware. To provide maximum flexibility at minimal cost, the invention communicates via the network in accordance with a robust, flexible and widely recognized communications protocol such as SNMP.

[0009] Other aspects of the invention are directed to particularly stable methods of controlling certain aspects of normal system operations (such as enabling a port) to thereby minimize, if not entirely eliminate system instability and, by extension, system failure and troubleshooting. The invention achieves this result by practicing stable hardware enable and disable sequences.

[0010] In the event that system failure does occur for some reason, the invention facilitates troubleshooting of system errors by avoiding the need to physically inspect the managed hardware in order to identify the various hardware utilized, to determine their connectivity and to determine the operational status of each component. This advantage obtained through the use of system hardware and software identity, configuration and status viewing capabilities enabled by information retrieval via the network. The invention also provides an extensive array of log messaging features that further facilitate system troubleshooting and monitoring.

[0011] Naturally, the above-described methods of the invention are particularly well adapted for use with the above-described apparatus of the invention. Similarly, the apparatus of the invention are well suited to perform the inventive methods described above.

[0012] Numerous other advantages and features of the present invention will become apparent to those of ordinary skill in the art from the following detailed description of the preferred embodiments, from the claims and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The preferred embodiments of the present invention will hereinafter be described in conjunction with the appended drawing figures, wherein like numerals denote like elements, and wherein:

[0014] Figure 1a illustrates the hardware architecture of a transport multiplexer in accordance with one preferred embodiment of the present invention;

[0015] Figure 1b illustrates a preferred form of the firmware host processor architecture of the transport multiplexer of Figure 1a;

[0016] Figure 2 illustrates system initialization and resource discovery processes for the transport multiplexer of Figure 1, the processes being in accordance with one preferred embodiment of the present invention;

[0017] Figure 3 illustrates various system hardware attribute viewing capabilities in accordance with one preferred embodiment of the present invention;

[0018] Figure 4 illustrates system attribute viewing capabilities in accordance with one preferred embodiment of the present invention;

[0019] Figure 5 illustrates various output port enabling processes in accordance with one preferred embodiment of the present invention;

[0020] Figure 6 illustrates specification of present video and/or audio stream routing event(s) in accordance with one preferred embodiment of the present invention;

[0021] Figure 7 illustrates various system bandwidth utilization viewing capabilities in accordance with one preferred embodiment of the present invention;

[0022] Figure 8 illustrates certain event logging and viewing capabilities and processes in accordance with one preferred embodiment of the present invention;

[0023] Figure 9 illustrates specification of future content stream routing event(s) in accordance with one preferred embodiment of the present invention;

[0024] Figure 10 illustrates various IP data encapsulation and insertion capabilities in accordance with one preferred embodiment of the present invention; and

[0025] Figure 11 is a detailed flow chart illustrating the IP data encapsulation and insertion capabilities of Figure 10 in greater detail.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] The ensuing detailed description provides preferred exemplary embodiments only, and is not intended to limit the scope, applicability, or configuration of the invention. Rather, the ensuing detailed description of the preferred exemplary embodiments will provide those skilled in the art with an enabling description for implementing a preferred exemplary embodiment of the invention. It being understood that various changes may be made in the functional arrangement of elements without departing from the spirit and scope of the invention as set forth in the appended claims.

[0027] As shown in Figures 1a and 1b, TMX 20 includes a plurality of hardware, firmware and software components. Figure 1a is a hardware architecture diagram showing a representative transport multiplexer (TMX) 20 in accordance with one preferred embodiment of the present invention. As shown therein, the transport multiplexer can include, for example, a computer 22' (with an element manager 22 and a GUI 80) that is communicatively linked to a TMX chassis 42 via a network 24. TMX chassis 42 preferably includes a host processor board 40' (preferably with a VxWorks operating system), an input processor board 50', and output processor board 55', a multiplexer board 60' and a transcoding board 70'. These components are preferably, but not necessarily communicatively linked to one another with a single TMX chassis 42. The basic physical model of the preferred TMX chassis hardware is as follows: the TMX chassis is a container for boards, each board is a container for ports and processors, each processor is a container for firmware, and each port is a container for a protocol hierarchy (i.e., DS3, MPEG, TCP/IP, etc.). The chassis and each board have a set of state and status variables associated with them. These include: 1) an administrative state which is used to synchronize configuration access of multiple managers; 2) an operational state which is used to indicate whether or not the TMX (or a component of it) is in a fully enabled and operational state; and 3) an alarm status which is used to signal a variety of

alarm conditions by the TMX or a component thereof. As described in detail below, the host processor 40 controls the various hardware and software components of TMX 20 and stores MIB table data in accordance with SNMP for use by the various other components of the TMX and the element manager.

[0028] Transport multiplexer 20 is suited to a wide variety of application environments including: (1) cable headend; (2) satellite uplink; and (3) terrestrial broadcast. Communication between element manager 22 and TMX chassis 42 is preferably performed in accordance with a modified Simple Network Management Protocol (SNMP) and the content streams to be routed through transport multiplexer 20 are preferably in accordance with one of the well-known MPEG standards. Most preferably, the content streams are MPEG2 data streams. While some preferred embodiments of the present invention use some conventional MIB tables in accordance with well known SNMP standards, many of the MIB's referenced herein comprise novel data structures. These data structures are fully defined in the computer program provided at the end of this specification. Therefore, those of ordinary skill will more than amply understand the nature and function of those novel data structures based on the teachings contained herein.

[0029] A more detailed description of the hardware components of TMX 20 is provided in previously mentioned co-pending U.S. Patent Application, Serial No. ____/____,____, filed April 16, 2002 and entitled "High Speed Serial Data Transport Between Communications Hardware Modules," which Application has been incorporated herein by reference. Accordingly, further detailed discussion of these hardware components is not necessary, a complete understanding of these components being achieved with reference to these incorporated applications.

[0030] The relationship between physical and logical resources in the system needs to be manipulated and communicated between TMX chassis 42, element manager 22 and human operators 10 (e.g., Figure 2). This is generally achieved by modeling the various hardware components of the system. The TMX modeling elements are integrated

into the SNMP Management Information Base (MIBs) by using the standard "MIB 2" interfaces table (ifTable) to represent each one of the modeling elements as an interface with specific extensions as specified below. This permits identification of any board and/or any port, by its table index: the ifindex in the ifTable.

[0031] With continuing reference to Figure 1a, element manager 22 is preferably linked to TMX chassis 42 by an Ethernet. It will be appreciated by those skilled in the art that other network technologies can alternatively be used. Element manager 22 may be uploaded as a java-application from TMX 42 to a remote computer using a browser, the remote computer preferably being communicatively linked to transport multiplexer 20 via network 24 during an initial set-up phase. Subsequently, element manager 22 can be run on the remote computer as a java program. The remote computer is preferably a conventional personal computer with a conventional operating system and browser, the system permitting control over TMX chassis 42 subsequent to installation of element manager 22. A graphical user interface (GUI) is preferably incorporated into element manager 22 and is described in detail below. The GUI is preferably presented to an operator on a conventional personal computer monitor (e.g., an LCD screen or a CRT monitor). A wide variety of alternative software and hardware components for hosting and operating graphical user interface and element manager 22 will readily occur to those of ordinary skill in the art based on the disclosure contained herein

[0032] Figure 1b illustrates various firmware and software components 52-69 of TMX 20 which are communicatively linked to one another as shown therein. These components include an SNMP agent 44, a message handler 45 and a fault manager 59. TMX 20 further comprises a resource manager 52, a configuration manager 46, a PAT/PMT collection module 54, a PSIP collection module 57, an input module 50, an IP encapsulation module 66, a time table manager 67 and a number of DSP API's. These include multiplexer processing 60, transcode processing 62 and quantization level processing 64. There is a one-to-one correspondence between these firmware modules

and certain hardware components of the preferred embodiment. The corresponding hardware components can be found in Figure 1a and include input processor board 50', multiplexer board 60' (with a multiplex processor 60 and a quantization level processor 61), a transcoding board 70' (with either 5 transcode processors 71 or 3 transcode processors, 1 multiplex processor and 1 QLP 71'). Consequently, when the configuration manager performs operations on the firmware modules, the corresponding hardware modules are also affected. The flow of information and commands between the various components within TMX chassis 42 is generally indicated in Figures 1a and 1b by the use of arrows. In particular, the flow of commands and information from element manager 22 is through SNMP agent 44, which translates SNMP protocol commands from element manager 22 into a conventional form so that they can be understood by the various other components of TMX 20. The preferred conventional communication protocol is a simple protocol in which a number indicative of a request or command is passed along with an associated data structure for receiving data to be manipulated in accordance with the associated command. Thus, SNMP agent 44 generally acts as a communication broker between element manager 22 and the host processor firmware. SNMP agent 44 allows SNMP based management of and control over firmware functionality such as grooming, splicing, data insertion, etc., because it provides an interface with the various firmware modules (e.g., input processing task 50, multiplexer processing 60, transcode processing 62 and quantization level processing 64) that ultimately provide the desired functionality.

[0033] Configuration manager 46 receives commands and information from SNMP agent 44 via MIB message handler 45 and determines how to utilize the hardware and other firmware to execute those commands at the card level. A detailed understanding of the various other components of TMX 20 will be obtained with reference to Figures 2 through 9 and the corresponding detailed description of these figures in the remainder of this specification.

[0034] Figures 2 through 11 illustrate the nine primary operational aspects of transport multiplexer 20. These nine operational aspects include (1) initialization and

discovery of system resources 100; (2) view system hardware attributes 134; (3) view system software attributes 156; (4) enable output port 166; (5) specify present video and/or audio routing event(s) 184; (6) view bandwidth utilization 206; (7) view log activity 222; (8) specify future routing event(s) 238; and (9) IP data encapsulation and insertion 260. These aspects of the present invention are discussed in detail immediately below.

[0035] With reference to Figure 2, there is illustrated therein system initialization and resource discovery processes for the broadband multiplexer of Figure 1, the processes being in accordance with one preferred embodiment of the present invention. As shown, initialization and discovery of the inventive system commences with power-up 101 of TMX chassis 42, whereupon resource manager 52 conducts discovery (at 102) of the hardware and system software information. Thus, TMX chassis 42 executes a number of functions at 104 to identify system components installed in TMX chassis 42. Also at 102, MIB message handler 45 populates the appropriate MIB's (ifTable and ifStack) with information and SNMP agent 44 awaits queries at 106. Upon completion of these tasks, TMX chassis 42 is prepared to execute various activities based on operator-driven commands delivered to TMX chassis 42 via element manager 22.

[0036] At this point, an operator 10 can start up element manager 22 in response to which the element manager, at 104, displays graphical user interface 80 showing a blank tree view screen 81 for viewing. Blank tree view screen 81 includes an input tree window 82, an output tree window 82' and a log message window 87. At 108, element manager 22 automatically reads the appropriate MIB's to discover the hardware that is currently installed in TMX 20. This includes system hardware attribute data such as port data and/or physical structure. There are several types of ports (e.g., ASI, DHEI, SMPTE 310, DS3) which are supported by the preferred embodiment of the present invention. Data for various port parameters is described /defined by the ifentry MIB table. At 110, element manager 22 downloads the appropriate DSP code to the IdentxTable MIB. SNMP agent 44 of TMX chassis 42 creates a new MIB entry at 112

and message handler 45 passes this information to configuration manager 46 for fulfillment. At this point, element manager 22 requests PAT data at 114. This request is processed by the TMX at 116. At 120, the PAT is parsed by element manager 22 so that the appropriate PMT's can be identified. These are requested at 122 and this request is processed by the TMX at 124. After the requested information is generated, SNMP agent 44, awaits further queries at 126. This data is then read by element manager 22 at 128 and graphical user interface 80 is updated. In particular, the requested data is used to populate tree view screen 81 with system hardware icons 84 and 84' and, preferably mnemonic, hardware names 83 and 83' extracted from the data streams themselves using PSIP collection module 57. Operator 10 is, thus, presented with a visual representation of the system hardware components.

[0037] After receiving the system hardware attributes data from TMX chassis 42, element manager 22 proceeds to retrieve and display log messages that may have been generated at 130. This is achieved with the assistance of a fault manager 59 and SNMP agent 44 at 132. Thus, once log polling has commenced, element manager 22 displays the port and log data at 132 to graphical user interface 80 where the tree view screen is updated to display input ports 85, output ports 85' and log messages 88 in log message window 87. As shown, input and output ports 85 and 85' preferably have associated mnemonic and alphanumeric identifiers. The ports are also preferably color coded to indicate whether or not the ports are active. Upon reviewing the newly completed tree view screen 81, operator 10 can initiate various activities as described below with respect to Figures 3 through 10. These activities can include, for example, view system hardware attributes 134, view system software attributes 156, enable output port 166, specify present video and/or audio routing events 184, view bandwidth utilization 206, view log activity 222, specify future routing events 238 and IP data encapsulation and insertion event(s) 260. Various other related activities that can be performed by operator 10 will readily occur to those of ordinary skill in the art based on the disclosure contained herein.

[0038] Turning now to Figure 3, this Figure illustrates various system hardware attribute viewing processes 134 in accordance with one preferred embodiment of the present invention. The hardware processes shown in Figure 3 are initiated by operator 10 upon selection of the chassis view screen from the menu items at the top of tree view screen 81. This option is accessed by selecting the "view" menu item at the top of the screen and selecting the chassis view option. Available hardware viewing options include "front chassis view" and "rear chassis view" and "system information." Upon selection of one of the chassis view options at the graphical user interface, element manager 22 gathers the requested hardware information from the appropriate MIB's (136) with the assistance of TMX chassis 42. This MIB data is provided by TMX chassis 42 as indicated by 138 and element manager 22 then displays the information on one of chassis view screen 89 and 90.

[0039] With continuing reference to Figure 3, one can see that graphical user interface 80 uses the received hardware and status data to display system hardware attributes and, in particular, chassis view screens 89 and 90 as initially requested by operator 10. Front chassis view screen 89 includes various graphical objects indicative of the identity of, physical structure of, configuration of and status of the various cards received within TMX chassis 42. In this illustrative example, these cards include CPU card 40", multiplexer card 60", first input processor board 50" and second input processor board 50". While it is also possible to receive log messages within log message window 87 of front chassis view screen 89, no log messages have been generated in this illustrative example.

[0040] Rear chassis view screen 90 can also be selected by operator 10 as an alternative to front chassis view screen 89. In this illustrative example, rear chassis view screen 90 includes various graphical objects indicative of the identity of, physical structure of, configuration of and status of the rear portion of the various cards received within TMX chassis 42 and discussed above with respect to the front chassis view. The log messages can, optionally, also be displayed in log message window 87 of rear chassis

view screen 90. This aspect of the present invention allows an operator 10 to easily select, and then, view system hardware attributes in the manner discussed above. This feature of the present invention is particularly advantageous in that it allows an operator to troubleshoot difficulties with transport multiplexer 20 without having to physically access the communications hardware itself.

[0041] The preferred continuous hardware status polling features of the present invention are shown at 139. In particular, the LED status information provided in the chassis view screens is updated at regular intervals by the repeated execution of the functions shown in blocks 140 – 146.

[0042] Turning now to Figure 4, this figure illustrates system attribute viewing processes and capabilities 156 in accordance with one preferred embodiment of the present invention. As shown therein, viewing of system attributes such as board type, DSP attributes, software version, etc. commences with the initial system discovery process when the TMX executes the functions shown at 158. Thus, this information is readily available for display and SNMP agent 160 waits for such queries at 160. Upon selection of the version view menu option within the top portion of tree view screen 81 by operator 10, element manager 22 gathers the requested information at 162 displays it in system attributes screen 91. The data can then be viewed by operator 10 as desired. As shown in Figure 4 and Table 1 below, system attributes data displayed on screen 91 preferably includes the following data fields for the board and software running on each chassis slot:

Table 1
Board Name
TMX Application
JVM Version
System Name
IP Address
Chassis ID
Board Revision
FPGA Version
VxWorks 08
CPU Version
MAP Lib Version
MUX Version
QLP Version
TPE Version

[0043] In the illustrative embodiment of Figure 4, TMX chassis 42 is a mid-plane TMX chassis with five board slots in each half of the chassis. Accordingly, this illustrative example includes ten slots (five slots for each half-plane). A detailed description of the structure and operation of TMX chassis 42 is contained in the application incorporated by reference and a wide variety of variant arrangements will readily occur to those of skill in the art based on the disclosure contained herein.

[0044] As shown in Figures 3 and 4, the preferred embodiment of the present system includes a GUI with a system information tab with which an operator can access information about the system such as system name, system description, system up-time and system location. This feature of present invention operates in a manner that is generally analogous to the view software version feature shown in Figure 4 and described in connection therewith immediately above

[0045] Figure 5 illustrates various output port enabling capabilities in accordance with one preferred embodiment of the present invention. As shown therein, output port enabling is initiated upon selection by operator 10 of the particular port to be enabled. Upon selection of a port, element manager 22, at 168, displays the transport editor 92 with default values. Operator 10 can then view the default data and edit the data if desired, such as by changing the status from disabled to enabled. For example, an operator will typically enable a transport stream, name that stream and assign an information transfer bit rate for the selected port. Upon selection of the "OK" button, the transport editor is closed, and element manager 22 gathers transport information from the editor and places it in the appropriate MIB tables (see 170). The TMX chassis also uses this information to execute the enable request as indicated at 172. The MIB table could be either one of two types: TMXiftable (for most ports) or the TMXgiexttable (for DS3 ports) due to the varying information requirements of the different port types.

[0046] Further, element manager 22 creates a PAT at 174 and the PAT is output by the TMX as indicated at 176. Finally, the tree view screen 81 of the GUI is updated by the element manager as indicated at 178. Graphical user interface 80 indicates successful enablement of the desired port by changing the attributes of the port icons in tree view screen 81. This is preferably accomplished by changing the color of the port icons, but other alternatives (such as changes in shape, movement, location, size, sound, etc.) will readily occur to those of ordinary skill in the art. Operator 10 can, thus, visually confirm that port enablement was successfully completed by viewing the newly-updated graphical user interface 80.

[0047] Figure 6 illustrates various system-assisted video and/or audio routing capabilities in accordance with one preferred embodiment of the present invention. As described in greater detail below, the present invention enables operator 10 to define and execute content stream routing either manually or semi-automatically. In particular, the preferred embodiment of the present invention provides operators with the ability to manually enter routing data element by element or, alternatively, to drag and

drop graphical objects to and from various locations of the tree view screen 81. Element manager 22 cooperates with graphical user interface 80 to execute the various routing specification commands specified by corresponding drag and drop operations. This is achieved with automated population of MIB tables corresponding to the various actual fields necessary to define a routing command. Drag and drop operations on graphical user interface 80 assist operator 10 in defining video, audio and/or IP data routing events for the system. Defining routing specifications in this way is, therefore, semi-automatic.

[0048] Drag and drop operations on the graphical user interface can be used to perform a variety of related content stream routing functions. These include the ability to drag different levels from the input tree to the output tree. For example, an operator may drag (1) the content streams of an entire input port (possibly including plural programs, each of which possibly includes plural components) to an output port; (2) a complete program of an input port to an output port; (3) a complete program from an input port to a program of an output port; and (4) a component from an input port to an output port. A number of other drag and drop features will readily occur to those of ordinary skill in the art based on the disclosure contained herein. However, it should be noted that this portion of the specification specifically addresses content stream routing that occurs in the present. The invention, however, also envisions configuration of content stream routing to be automatically executed at a future time (see, e.g., Figure 9). As described in greater detail below, content stream routing processes described immediately below (applicable to execution of present routing commands) are compatible with, and form a portion of, routing processes for execution of routing events in the future.

[0049] With primary reference to Figure 6, operator 10 can specify one or more present routing events by selecting the graphical objects representing one or more content streams to be routed to a desired location (e.g., an output port). The content stream could be either simple or contain plural components which may or may not be related to one another in one or more ways. For example, the object may represent a single component content stream, plural content streams that collectively constitute a

program, or plural content streams that collectively constitute data streams present on an entire input port. In the illustrative example discussed immediately below, operator 10 drags the content streams for an entire port from the input tree to the output tree and proceeds to edit video and audio components of one program from the port.

[0050] Assisted routing in accordance with the invention is preferably accomplished with a drag and drop operation of one or more graphical objects from the input port window 82 to the output port window 82' of tree view screen 81. This operation has the effect of capturing, as indicated at 186, configuration data corresponding to the selected source of the data stream(s). For example, dragging and dropping the desired graphical objects enables element manager 22 to automatically capture corresponding configuration data for the desired routing events such as input port number and location, output port number and location, content stream PID to be routed and bit rate for the content streams to be routed. Additionally, information regarding the targeted output port (determined based on where the object is dropped) is also captured (188) by element manager 22 and includes, for example, the location of the targeted output port. This information enables element manager 22 to create default settings and to automatically perform PID aliasing at 186 so that there are no data stream conflicts as the various streams are routed through transport multiplexer 20. The drag & drop editors 93 and 94 are then displayed by element manager 22 as indicated at 188. The operator can then select the particular component to be edited and, at 192, element manager 22 receives the selection and displays a component editor (95 for video streams or 95' for audio streams) with default information for possible editing. If the default data shown in the component editor 95 is acceptable to the operator, the "OK" button can be selected to cue the element manager to take further action. In particular, closing of the component editor window causes element manager 22 to gather the information from the GUI and to request the creation of various MIB table entries as shown at 194. The TMX executes the routing events in accordance with the updated MIB's at 196 and the GUI is appropriately updated by the element manager 22 as indicated at 198. From the operator's perspective,

routing has been specified and performed simply by dragging and dropping an icon from the input tree to an output tree. In actuality, a variety of routing parameters have been specified with the assistance of the system as described in detail above.

[0051] If operator 10 wishes to modify the default and/or captured data, operator 10 has the ability to edit the information in detail for each of the components that comprise the content stream. In the example shown, operator 10 has selected program 1 (in general, an operator would select some type of graphical object, such as an icon or its associated text) shown in editor window 93 and a more detailed editor window 94 is displayed, the window showing the constituent components of the selected program. In the case of Figure 6, program 1 has been selected for editing and it includes one video component and one audio component.

[0052] Graphical user interface 80 preferably has the capability of identifying content streams using a variety of graphical objects which include icons, alphanumeric character strings, actual program names, etc. on the various screens. The content stream identification data is preferably carried within the media stream so that it can be consistently displayed throughout the graphical user interface regardless of which viewing screen is presented to operator 10. Restated, graphical user interface 80 preferably presents a consistent content stream name or symbol and can display it throughout the interface.

[0053] With continuing reference to Figure 6, selection of the "OK" button of window 94 closes the drag and drop window and opens the component editor windows corresponding to the selected components as indicated at 192. In this case, selection of a component to be edited further results in display of one of component editor windows 95 and 95' where operator 10 has the further ability to specify details such as bit rate, target PID, etc. for any of the components of the desired program. In this case, video editor window 95 and audio editor 95' are displayed for consideration and possible editing. This feature enables a user to more easily allocate bandwidth among the various content streams being routed so that maximum bandwidth utilization can be achieved.

[0054] Upon selection of the "OK" button of one of windows 95 or 95', the element manager 22 changes the MIB table data in accordance with the edited changes and instructs the TMX to execute the specified routing configuration. Configuration manager 46 then sequentially configures the targeted multiplexer and quantization level processor and enables the input processor, in that order, as indicated at 196.

[0055] The module activation order, when an output port is enabled, is an important aspect of the present invention. In order to effectively execute a routing event, the targeted multiplexer, quantization level processor and input processor should be activated in the order specified to minimize the possibility of the destabilizing the system. In particular, configuration manager 46 directs the targeted multiplexer to collect the designated PIDs and route them to the targeted output. Second, the configuration manager 46 must provide the quantization level processor 64 with the appropriate bit rate and PMT for the content stream to be routed. Third, configuration manager 46 should instruct the input processor to send all of the content streams with a particular PID to the multiplexer. This is preferably accomplished by performing PID aliasing and then sending the associated data to the multiplexer as a low voltage differential signal.

[0056] As noted above, module activation in an order other than that discussed above may lead to system instability. If, for example, the configuration manager attempted to enable the input processor first, the multiplexer may begin to receive a content stream that it does not expect and this confusion may cause the multiplexer to crash. Similarly, removing a content stream (ceasing to route the stream to the port) should be performed in a predetermined order dictated by configuration manager 46. In particular, the sequence noted above should be reversed (deactivation of the input processor, deactivation of the QLP and, finally, deactivation of the multiplexer). If, for example, the multiplexer were disabled first, the multiplexer may still receive a content stream from the input processor and, once again, this condition may crash the multiplexer.

[0057] Turning now to Figure 7, this figure illustrates various system bandwidth utilization viewing capabilities in accordance with one preferred embodiment

of the present invention. As shown therein, operator 10 initiates the view bandwidth utilization feature of the invention by selecting the bandwidth manager menu item from the upper portion of tree view screen 81. This enables element manager 22 to display the bandwidth manager screen at 208 and the TMX begins polling the system for bandwidth utilization data and waiting for queries for this data as shown at 210 – 212. As indicated more fully in the accompanying computer program, the MIB tables enable monitoring of MPEG input/output bandwidth utilization information. In particular, the TMXinputPIDtable is used for input rate monitoring per PID. The TMXoutputPIDtable is used for output rate monitoring per PID.

[0058] In particular, message handler 45 begins polling input processor and output multiplexers for data that is used to update the MIB tables (capturing data from these two sources allows the bandwidth display to show a comparison between the input bandwidth and output bandwidth) and sends the data as SNMP data to element manager 22, as indicated at 214. Element manager 22 periodically queries the TMX for this information and at 216 displays this data on graphical user interface 80. It then returns to continue polling for new bandwidth utilization data at 214. In this way, bandwidth utilization data for all enabled ports is continually updated and can be displayed by graphical user interface 80 in real-time. Bandwidth data polling preferably ceases when operator 10 closes the bandwidth windows 96 and 96' such as by switching to the chassis or tree view screens. At that point, the PID's for the enabled content streams are deleted from the MIB tables.

[0059] Upon receipt of bandwidth utilization data, graphical user interface 80 displays a bandwidth utilization screen 96. This screen preferably includes automatically rescaling x and y axes and an individual graphical object for each content stream being routed, each object preferably being a bandwidth bar (bars 97, 97' and 97" in the example shown). Each bandwidth bar shown in screen 96 preferably includes the following plural attributes: an output bandwidth utilization value 97a, an input bandwidth utilization value 97b, a maximum input bandwidth utilization value 97c and minimum input bandwidth

utilization value 97d. In practice, changes in the bandwidth utilization are automatically displayed in bandwidth utilization screen 96 in real-time.

[0060] Bandwidth utilization screen 96 can include a number of user-friendly features to make the graphical user interface even more intuitive and useful. For example, operator 10 may be provided with the ability to select or deselect a legend display shown on the right hand portion of bandwidth utilization screen 96. Similarly, operator 10 preferably has the ability to select or deselect display of the minimum and maximum bandwidth utilization values. Furthermore, screen 96 preferably has the ability to display the same mnemonic identifiers for the various streams that are used in other screens such as the tree view screen. Restated, the graphical user interface preferably reflects a consistent identifier for each content stream throughout the system. Naturally, other identifiers could be used if desired. These identifiers are preferably sent with the content streams so that they can be detected and displayed in various screens. As noted above, the identifiers may be displayed as colored icons and/or alphanumeric character strings, etc.

[0061] After viewing bandwidth utilization screen 96, operator 10 may select one of the bandwidth bars to dynamically display more detailed information about the various components that make up the content stream for the selected bar. For example, a given program might include one video and two audio components. Selecting a bandwidth bar will cause detailed bandwidth utilization window 96' (with additional information about these components) to appear on the screen. This type of selection causes element manager 22 to generate a query at 216 which is responded to by the TMX at 210/212. As shown in window 96', the program name, the group ID and the total bandwidth at the instant that the bandwidth bar was taken are captured and displayed on the screen. In this illustrative embodiment, the bandwidth bar for program 2 was selected when the bandwidth utilization was about five megabits per second (compare windows 96 and 96' of Figure 7). Additionally, the detailed window breaks the selected program down

into its constituent components. In this case the program has three constituent parts: IP data 1, video data 1 and audio data 1.

[0062] The screen 96' shows even more detailed information for each component of the program. This information preferably includes a bandwidth minima value, a bandwidth maxima value and the instantaneous bandwidth utilization of the constituent components at the instant the detailed bandwidth utilization window was selected. With joint reference to screens 96 and 96', it will be appreciated that the displayed bandwidth utilization of the constituent components sums to the bandwidth utilization of the entire program. Additionally, the sum of the minimum values of the constituent components equals the minimum value for the program as a whole. Similarly, the maximum value for the entire program equals the sum of the minimum values for each of the constituent components. Finally, the display shows the packet identifier PID associated with the program.

[0063] Since this aspect of the system displays bandwidth in real-time, the operator will see the bandwidth utilization varying over time. Also, differences in bandwidth utilization at different points in time will reflect the fact that input signals can vary over time on the input side of the whole system. For example, if an input signal suddenly includes an additional component, the bandwidth display screen will reflect that change in real-time.

[0064] Figure 8 illustrates various event logging and viewing capabilities 222 in accordance with one preferred embodiment of the present invention. As shown therein, the system has the ability to filter the log messages displayed on the graphical user interface. Viewing log information in accordance with the present invention initially entails operator selection of an appropriate log filter level, thereby placing the system into one of four modes. The filter level is recorded by the element manager 22 and the number and type of messages displayed in the log message window 87 of graphical user interface 80 is dictated by the filter level. The desired log filter level can be selected from the "view" drop down menu item near the top of tree view screen 81 and then selecting the

log messages option. There are preferably four filter levels: normal status, emergency status, fault status and debug. In debug mode all of the generated log messages are displayed.

[0065] Upon startup, the TMX chassis 42 the status query task begins to poll the system to thereby generate log messages that are used to populate the TMXLogPortTable, as shown at 224. The SNMP agent 44 then waits to respond to for queries for this information as shown at 226. This log messages can be generated by any one of the various firmware modules and element manager 22, GUI 80 and TMX chassis 42 cooperate to continually pass log messages in accordance with the previously selected log level to the graphical user interface for display in the scrolling log message window. Additionally, these log messages are stored for possible retrieval and analysis in the future. Although the log messages presented to an operator in normal use can be filtered, all log messages generated by the system are preferably stored on the element manager's host computer. One separate log file is preferably generated for each day the system is in use and operator 10 has the ability to retrieve and view log messages for any given day in the log file archive screen 98.

[0066] Upon selection of the Log File Menu by operator 10, element manager 22 retrieves, displays and stores log files as indicated at 228. This screen is accessed by selecting the "view" menu item near the top of the tree view screen 81 and by then selecting the appropriate option. Upon selection of one of the daily log files from the list of log files in the archive screen 98, individual log messages from the selected log file are displayed for viewing on screen 98' as indicated at 230. When reviewing stored log messages, the operator also has the ability to filter the information by selecting one of the four filter levels as discussed above.

[0067] Figure 9 illustrates various future content stream routing capabilities 238 in accordance with one preferred embodiment of the present invention. Specification of future event(s) is initially driven by operator action on the tree view screen. In particular, upon initialization and discovery of the system, the system initially sets up one

routing event that spans the current time up to a predetermined time in the future (e.g., two years). This is shown in a time bar 99. Operator 10 can then select time bar 99, as shown in the upper right hand portion of tree view screen 81. The resulting pop-up menu allows operator 10 to either modify the displayed current event or to create a new event. In the case of specifying the future routing events, operator 10 would create a new event by selecting the create new event option and by specifying start and stop times for the new event. At that point, indicated at 240, another duplicate event (by default) is created by element manager 22. This information is then sent to the graphical user interface 80 for display and possible modification as shown at 241. The particular editor that is presented to operator 10 depends on what type of event will be created. In the representative example of Figure 9, audio and video editors 95 and 95' are presented. IP data streams could also be specified for a future routing event as will readily occur to those of ordinary skill based on the teachings contained herein. Once all of the various details for the various components of the future event has been completed, this information will be gathered by the element manager at 242 and displayed on screen 81'. As shown on screen 81', three events have been define in the illustrative example of Figure 9. At 244, element manager 22 requests that new entries be added to certain MIB's and TMX chassis 42 executes the configuration changes at 246. Also, element manager 22 updates the GUI at 252. This results in a tree view screen 81" that is substantially similar to that of screen 81', but that displays the routing trees according to the newly executed configuration.

[0068] Preferably, none of this future event configuration data is provided to TMX chassis 42 until shortly prior to the predetermined time for commencement of the newly defined future event. Then (e.g., about 30 seconds prior to the predetermined time), the entire configuration data is sent to TMX chassis 42 for execution. This routing event data is slightly different from that discussed above with respect to Figure 6, in that it also includes predetermined time data indicating when the new routing configuration is to occur. In this way operator 10 can configure the system to automatically change

configuration routing control at future predetermined points in time, even in the absence of the operator. Thus, the system permits automated control of the inventive broadband media hardware by predetermining routing configuration information for extended time periods and enabling automatic execution of such configuration changes.

[0069] Figure 10 illustrates various IP data encapsulation and insertion capabilities and processes 260 in accordance with one preferred embodiment of the present invention. As described in greater detail below, the present invention enables operator 10 to define and execute IP data encapsulation either manually or semi-automatically.

[0070] In particular, the preferred embodiment of the present invention provides operators with the ability to manually enter IP encapsulation configuration data element by element or, alternatively, to automatically enter IP encapsulation configuration data by dragging and dropping graphical objects to and from various locations of the tree view screen 81. Element manager 22 cooperates with graphical user interface 80 to execute the various routing commands specified by corresponding drag and drop operations. This is achieved with automated population of MIB tables corresponding to the various fields necessary to define a routing command. Drag and drop operations on graphical user interface 80 assist operator 10 in defining IP encapsulation specifications for the system in a manner substantially analogous to the semi-automatic definition of video and audio routing events shown and described with reference to Figure 6. Those of ordinary skill in the art will readily appreciate how to extend these concepts to implement drag and drop procedures in order to achieve semi-automated IP data encapsulation based on the teachings of this specification. Manual, or element by element, IP data encapsulation techniques are described immediately below with respect to Figures 10 and 11.

[0071] With primary reference to Figure 10, operator 10 can specify one or more IP data encapsulation events 260 by selecting the graphical objects representing a desired location (e.g., an enabled output port) from a tree view screen 262. Operator 10

can then select a particular program into which encapsulated IP data will be inserted. This enables element manager 22 to capture configuration data relating to the targeted output port and any programs that may be resident thereon at 264. In the representative example of Figure 10, program 1 has been selected for insertion of an IP data component. Responsive to operator selection of program 1, element manager 22 (at 266) displays a program editor 270 and sends default output port values from the to the graphical user interface for display. Operator 10 can then enter various values relating to a program into which an IP data component will be inserted with the assistance of element manager 22 at 272. General and detailed IP data component editors 274 will then be displayed so that a variety of other parameters can be specified by operator 10. Operator 10 has the ability to edit the add/remove/change detailed information in the IP data components editors for each of the components that comprise the content stream. In particular, operator 10 has the ability to specify details such as source and destination IP addresses, bit rate, target PID, etc. for each component of the selected program in the general and detailed editor windows 274. This feature enables a user to more easily allocate bandwidth among the various IP data streams being created so that maximum bandwidth utilization can be achieved. Up to 128 IP data streams may be simultaneously specified for encapsulation and insertion in this way.

[0072] Upon selection of the "OK" button of one of windows 274, element manager 22 executes a number of functions at 276. In particular, element manager 22 gathers the edited information from the GUI and requests that various new entries be placed into certain MIB tables with default and/or edited data (as shown at 276). Element manager 22 also provides this information to TMX 42 for execution as shown at 278 of Figure 10 and in Figure 11. In particular, at 278, SNMP agent 44 creates the new MIB entries, message handler 45 passes the information to configuration manager 46 which configures one or more multiplexers and instructs the IP encapsulation module 66 to begin collecting IP data. IP encapsulation module 66 then receives IP data from the specified source IP address, encapsulates each IP data packet as one or more MPEG

packets, to thereby form MPEG data streams, and sends them to the targeted multiplexer(s). The targeted multiplexer(s) receives the assembled MPEG data packets and stream the MPEG data appropriately. At 280, the element manager updates the graphical user interface 80 which displays the updated information on tree view screen 289. Operator 10 can then view an IP data icon 290 that indicates encapsulation and insertion of IP data is occurring.

[0073] The portion of block 278 that performs the IP encapsulation process is illustrated in detail in Figure 11. As shown therein, upon execution of IP encapsulation process 282, the encapsulation module 66 instructs IP data stack (of the operating system running on the host processor) to collect/receive and examine an IP data packet at 292. At 293 the module 66 then verifies that the system is prepared to process IP packets (e.g., the target multiplexer(s) has/have been properly configured). The destination IP address for the received IP data packet is then tested for validity at 294. In particular, the destination IP address is checked to determine whether it is the broadcast, unicast or multicast IP address. This is preferably accomplished by verifying that the destination address is within the multicast range and that the address has been specified for data collection/reception. If the IP address indicates that the IP packet is not a multicast packet, the determination is made that the IP data packet must be either a broadcast or unicast packet. If so, the data packet is passed through the operating system (OS) stack in a conventional manner and the process passes to 296 where it simply waits to receive the next IP data packet. In particular, the preferred OS (VxWorks) employs a standard seven-layer OSI compliant IP stack that processes each broadcast and/or unicast packet to determine its type and the application that it should process it. Thus, for example, a broadcast packet that is found to be an ARP request would be sent to the ARP task for processing.

[0074] Conversely, if the source IP address indicates that the IP data packet is a multicast IP packet, the packet cannot simply be routed through the OS stack because the OS will not recognize the data packet except in the unlikely event that it is the

intended recipient of the packet. Thus, if the IP address indicates that the data packet is a multicast packet and if that address is one of the 128 addresses that element manage 22 has indicated as being associated with IP data that is to be encapsulated, the IP data will be converted to a different form and routed without going through the IP stack as an IP data packet. To achieve this, the process first passes to 297 where the IP data packet is fragmented, if necessary, into smaller content components for processing. The process then passes to 298 where an MPEG data packet is assembled and sent to the appropriate multiplexer(s). In particular, a 4 byte MPEG header that includes the target PID for this packet is created at 300. Then, at 302 the destination IP address is extracted from the IP data packet and used to create a 16 byte DSM-CC (Data Storage Media Command and Control) header for the first MPEG data packet. A conventional 4 byte Cyclic Redundancy Code (CRC or CRC32) MPEG suffix is preferably also included in the last MPEG packet (e.g., following the last byte of content). Since the system can support output data in either one of DVB or ASTC data formats, the DSM-CC header also indicates which format the output data is in to thereby account for the differences between these formats. At 304, up to 168 bytes of content are added to the MPEG 188 byte packet being created. If this can hold all of the content to be sent, then a CRC is appended after the last byte of content. At 308, a determination is made whether any fill data is needed to complete the MPEG packet. If so, process 282 passes to 310 where the remainder of the MPEG packet is filled with dummy data. This data is preferably the numerical value of 255 (FF in hexadecimal) and is repeated until a complete 188 byte MPEG data packet has been formed. With this system of the preferred embodiment, a maximum of one IP data packet will be inserted into a single MPEG packet. If no fill is needed (or after the packet has been filled), the process passes to 312 where the assembled packet is sent to the targeted multiplexer and it is preferably stored in a FIFO for combination with additional MPEG packets, if any. Also, the process passes to 314 where it is determined whether or not the received IP data packet has been fully encapsulated. If so, the process passes to 316 where the multiplexer receives an

indication of how many MPEG data packets it has received together with an indication that this/these packet(s) should be transmitted. The process 282 then passes to 296 where the IP encapsulation module waits for the next IP data packet to be encapsulated.

[0075] If it is determined at 314 that the IP data packet has not been fully encapsulated, process 282 passes to 318 where additional content from the IP data packets are assembled into MPEG data packets and sent to the appropriate multiplexer. In particular, process 282 passes from 314 to 320 where an MPEG header for the next MPEG data packet is created. Up to 184 bytes of IP data and CRC (for the last MPEG packet) are then added to the packet at 322 and, at 326, a determination is made whether any fill data is needed to complete the MPEG packet. If so, process 282 passes to 328 where the remainder of the MPEG packet is filled with dummy data. This data is also preferably the numerical value of 255 (FF in hexadecimal) and is repeated until a complete 188 byte MPEG data packet has been formed. If no fill is needed (or after the packet has been filled), process 282 passes to 330 where the assembled packet is sent to the targeted multiplexer and it is preferably stored in a FIFO for combination with all prior and subsequent assembled MPEG packets, if any. Also, the process passes to 332 where it is determined whether or not the received IP data packet has been fully encapsulated. If not, steps 320 through 332 are repeated until the entire IP data packet has been encapsulated and, eventually, the process passes to 316 and 296 as noted immediately below. If so, the multiplexer receives an indication of how many MPEG data packets it has received together with an indication that these packets should be transmitted at 316. The process then passes to 296 where the IP encapsulation module waits for the next multicast IP data packet to be encapsulated. Process 282 terminates when operator 10 specifies a different function for the subject output port or when the time period for the specified event has expired. At that point, IP encapsulation module 66 awaits further instructions from configuration manager 46.

[0076] The following computer program listing sets forth the TMX-MIB definitions referred to above:


```

TMX-MIB DEFINITIONS ::= BEGIN
    IMPORTS
        NetworkAddress, IpAddress, Gauge, TimeTicks
            FROM RFC1155-SMI
        RowStatus, DisplayString, DateAndTime, TEXTUAL-CONVENTION
            FROM SNMPv2-TC
        MODULE-COMPLIANCE, OBJECT-GROUP
            FROM SNMPv2-CONF
        ifIndex
            FROM RFC1213-MIB
        Counter32, Integer32, OBJECT-TYPE, MODULE-IDENTITY FROM SNMPv2-SMI
        bmr FROM NLS-BBNIDENT-MIB;

    tmxMIB MODULE-IDENTITY
        LAST-UPDATED "0112202341Z"
        ORGANIZATION "Motorola BCS"
        CONTACT-INFO "John Sanders, Ext 3505 4A31"
        DESCRIPTION
            "TMX MIB Version 1.1a"
        REVISION "0008141355Z"
        DESCRIPTION
            ""
        ::= { bmr 1 }

    ActionTriggerType ::= TEXTUAL-CONVENTION
        STATUS current
        DESCRIPTION
            "Type of trigger mechanism for execution of
            an operation"
        SYNTAX BITS {
            operationCreation(0),
            activationTime(1),
            spliceImmediateFlag(2)
        }

    org OBJECT IDENTIFIER
        ::= { iso 3 }

    dod OBJECT IDENTIFIER
        ::= { org 6 }

    internet OBJECT IDENTIFIER
        ::= { dod 1 }

    private OBJECT IDENTIFIER
        ::= { internet 4 }

    enterprises OBJECT IDENTIFIER
        ::= { private 1 }

    tmxMIBObjects OBJECT IDENTIFIER
        ::= { tmxMIB 1 }

    tmxMIBConformance OBJECT IDENTIFIER
        ::= { tmxMIB 2 }

```

```

tmxMediaInterfaces OBJECT IDENTIFIER
    ::= { tmxMIBObjects 1 }

tmxMediaControl OBJECT IDENTIFIER
    ::= { tmxMIBObjects 2 }

tmxMediaMonitor OBJECT IDENTIFIER
    ::= { tmxMIBObjects 3 }

-- TMX specific extensions to the MIB 2 Interfaces Table

tmxNetTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF TmxNetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        " This is the network table associating TMX interfaces
(ifIndex)
        with other types of equipment."
    ::= { tmxMediaInterfaces 1 }

tmxNetEntry OBJECT-TYPE
    SYNTAX      TmxNetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION  "tmxNetTable entry"
    INDEX       { ifIndex, tmxNetIndex }
    ::= { tmxNetTable 1 }

TmxNetEntry ::= SEQUENCE {
    tmxNetIndex          Integer32,
    tmxNetEqpType        BITS,
    tmxNetEqpName        DisplayString,
    tmxNetEqpIpAddress   IpAddress,
    tmxNetEqpOperationalState Integer32,
    tmxNetEqpAlarmStatus Integer32,
    tmxNetEqpHeartBeatMonitor IpAddress,
    tmxNetEqpRedundancyGroup DisplayString,
    tmxNetEqpBackUp      IpAddress,
    tmxNetEntryStatus    RowStatus
}

tmxNetIndex OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION  "Identifier index for this networked equipment."
    ::= { tmxNetEntry 1 }

tmxNetEqpType OBJECT-TYPE
    SYNTAX      BITS { se1000(0), se2000(1), tmx(2),

```

```

                                dataServer(3), adServer(4),
computer(5) }
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "Type of equipment adjacent on ifIndex interface."
    ::= { tmxNetEntry 2 }

tmxNetEqpName          OBJECT-TYPE
    SYNTAX              DisplayString
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "Unique user assigned name to the physical
equipment."
    ::= { tmxNetEntry 3 }

tmxNetEqpIpAddress     OBJECT-TYPE
    SYNTAX              IPAddress
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "IP Address of the adjacent equipment."
    ::= { tmxNetEntry 4 }

tmxNetEqpOperationalState OBJECT-TYPE
    SYNTAX              Integer32
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "OperationalState of this networked equipment."
    ::= { tmxNetEntry 5 }

tmxNetEqpAlarmStatus   OBJECT-TYPE
    SYNTAX              Integer32
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "AlarmStatus of this networked equipment."
    ::= { tmxNetEntry 6 }

tmxNetEqpHeartBeatMonitor OBJECT-TYPE
    SYNTAX              IPAddress
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "Heart beat monitor for this networked equipment."
    ::= { tmxNetEntry 7 }

tmxNetEqpRedundancyGroup OBJECT-TYPE
    SYNTAX              DisplayString
    MAX-ACCESS          read-create

```

```

        STATUS          current
        DESCRIPTION      "Unique name of the redundancy group of this
networked equipment."
        ::= { tmxNetEntry 8 }

tmxNetEqpBackUp          OBJECT-TYPE
    SYNTAX               IPAddress
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION           "IP Address of the back up of this networked
equipment."
    ::= { tmxNetEntry 9 }

tmxNetEntryStatus        OBJECT-TYPE
    SYNTAX               RowStatus
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION           "Status of this entry."
    ::= { tmxNetEntry 10 }

-- tmxMediaControl consists of tables used to configure the TMX media control
-- functionality.

tmxOpNum                 OBJECT-TYPE
    SYNTAX               INTEGER
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION           "The number of last Op created."
    ::= { tmxMediaControl 1 }

tmxToaLock                OBJECT-TYPE
    SYNTAX               BITS { unlock(0), lock(1)}
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION           "The number of last Op created."
    ::= { tmxMediaControl 2 }

tmxToaLockTime            OBJECT-TYPE
    SYNTAX               INTEGER
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION           "The time (in second) to wait before starts executing
the unlock operation"
    ::= { tmxMediaControl 3 }

tmxDeleteAll              OBJECT-TYPE
    SYNTAX               BITS { delete(0), keep(1)}
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION           "The flag indicates the deletion of the entire media
control database"

```

```

        ::= { tmxMediaControl 4 }

tmxReserved          OBJECT-TYPE
    SYNTAX             INTEGER
    MAX-ACCESS         read-create
    STATUS             current
    DESCRIPTION        "The number of last Op created."
    ::= { tmxMediaControl 5 }
*****
**

tmxIfTable            OBJECT-TYPE
    SYNTAX             SEQUENCE OF TmxIfEntry
    MAX-ACCESS         not-accessible
    STATUS             current
    DESCRIPTION        " This is the TMX specific extension of ifTable."
    ::= { tmxMediaControl 6 }

tmxIfEntry            OBJECT-TYPE
    SYNTAX             TmxIfEntry
    MAX-ACCESS         not-accessible
    STATUS             current
    DESCRIPTION        "tmxIfTable entry"
    INDEX              { ifIndex }
    ::= { tmxIfTable 1 }

TmxIfEntry ::= SEQUENCE {
    tmxIfName          DisplayString,
    tmxIfTSId          Integer32,
    tmxIfType          BITS,
    tmxIfASIMode       BITS,
    tmxIfStandard      BITS,
    tmxIfTransportBitRate Integer32,
    tmxIfActionTrigger ActionTriggerType,
    tmxIfActionTime    DateAndTime,
    tmxIfIfIQ          BITS,
    tmxIfSttDestinationOffset Integer32,
    tmxIfSttDsStatus   BITS,
    tmxIfSttDsDay      Integer32,
    tmxIfSttDsHour     Integer32,
    tmxIfPacketLength  BITS,
    tmxIfEntryStatus   RowStatus
}
*****
**

tmxIfName            OBJECT-TYPE
    SYNTAX             DisplayString
    MAX-ACCESS         read-create
    STATUS             current
    DESCRIPTION        "User assigned name to the physical interface."
    ::= { tmxIfEntry 1 }

tmxIfTSId            OBJECT-TYPE
    SYNTAX             Integer32

```

```

MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Mpeg Transport Identifier associated with this
physical interface, if any."
 ::= { tmxIfEntry 2 }

tmxIfType
SYNTAX          OBJECT-TYPE
                BITS { asi(0), ds3-ansi(1), ds3-fsi(2),
                        dhe1(3), dhe1-high(4),
                        smpte310(5), ds3-rmi(6) }
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "tmxIfType."
 ::= { tmxIfEntry 3 }

tmxIfASIMode
SYNTAX          OBJECT-TYPE
                BITS { burst(0), byte(1) }
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Output ASI mode, burst or byte."
 ::= { tmxIfEntry 4 }

tmxIfStandard
SYNTAX          OBJECT-TYPE
                BITS { atsc(0), dvb(1), mpeg2(2), none(3),
dcii(4) }
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Output ASI standard."
 ::= { tmxIfEntry 5 }

tmxIfTransportBitRate
SYNTAX          OBJECT-TYPE
                Integer32
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Transport bit rate in Mbps."
 ::= { tmxIfEntry 6 }

tmxIfActionTrigger
SYNTAX          OBJECT-TYPE
                ActionTriggerType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Trigger type that will initiate this operation."
 ::= { tmxIfEntry 7 }

tmxIfActionTime
SYNTAX          OBJECT-TYPE
                DateAndTime
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION

```

"If trigger type is a time of action this object contains the time."

::= { tmxIfEntry 8 }

tmxIfIQ	OBJECT-TYPE
SYNTAX	BITS {combined(0), i-out(1), q-out(2), iq-split(3)}
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	

"Select IQ mux mode for this transport stream,

combined, I, Q or I&Q."

::= { tmxIfEntry 9 }

tmxIfSttDestinationOffset	OBJECT-TYPE
SYNTAX	Integer32
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	

"Offset from UTC as used in the STT. This may not be the same value as used by the TMX system and may vary between transport streams depending on destination"

::= { tmxIfEntry 10 }

tmxIfSttDsStatus	OBJECT-TYPE
SYNTAX	BITS { not-in-ds(0), in-ds(1)}
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	"Daylight savings status as used in the STT."

::= { tmxIfEntry 11 }

tmxIfSttDsDay	OBJECT-TYPE
SYNTAX	Integer32
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	

"Local day of month daylight savings status will change (1-31) as used in the STT."

::= { tmxIfEntry 12 }

tmxIfSttDsHour	OBJECT-TYPE
SYNTAX	Integer32
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	

"Local hour of day daylight savings status will change (0-18) as used in the STT."

::= { tmxIfEntry 13 }

tmxIfPacketLength	OBJECT-TYPE
SYNTAX	BITS { pkt188(0), pkt204(1)}
MAX-ACCESS	read-create

```

STATUS          current
DESCRIPTION      "Transport stream packet length."
::= { tmxIfEntry 14 }

tmxIfEntryStatus OBJECT-TYPE
SYNTAX          RowStatus
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION      "Status of this entry."
::= { tmxIfEntry 15 }

*****
**
tmxIfGiExtTable OBJECT-TYPE
SYNTAX          SEQUENCE OF TmxIfGiExtEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION      " This is the extension table defining the DS3-GI TMX
interface
parameters."
::= { tmxMediaControl 7 }

tmxIfGiExtEntry OBJECT-TYPE
SYNTAX          TmxIfGiExtEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION      "tmxIfGiExtTable entry"
INDEX           { ifIndex }
::= { tmxIfGiExtTable 1 }

TmxIfGiExtEntry ::= SEQUENCE {
    tmxIfGiExtCodeRate      BITS,
    tmxIfGiExtSymbolRate    BITS,
    tmxIfGiExtModType        BITS,
    tmxIfGiExtPowerLevel     Integer32,
    tmxIfGiExtCarrierFrq     Integer32,
    tmxIfGiExtCwMode          BITS,
    tmxIfGiExtMute            BITS,
    tmxIfGiExtEntryStatus    RowStatus
}
*****
**

tmxIfGiExtCodeRate OBJECT-TYPE
SYNTAX          BITS { cr-5-11(0), cr-1-2(1), cr-3-5(2),
                      cr-2-3(3), cr-3-4(4), cr-4-5(5),
                      cr-5-6(6), cr-7-8(7) }
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION      "Code rate: 5/11, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6,
7/8"

```



```

::= { tmxIfGiExtEntry 1 }

tmxIfGiExtSymbolRate      OBJECT-TYPE
    SYNTAX                  BITS { sr-38-8(0), sr-29-27(1),
                                sr-19-51(2), sr-14-63(3),
                                sr-11-71(4), sr-9-76(5),
                                sr-7-32(6), sr-4-88(7),
                                sr-3-25(8), sr-2-44(9),
                                sr-1-83(10) }
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION              "Symbol rate: 38.8 29.27, 19.51, 14.63, 11.71,
                                9.76, 7.32, 4.88, 3.25, 2.44, 1.83"
::= { tmxIfGiExtEntry 2 }

tmxIfGiExtModType         OBJECT-TYPE
    SYNTAX                  BITS { qpsk(0), bpsk(1), oqpsk(2) }
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION              "Modulation type."
::= { tmxIfGiExtEntry 3 }

tmxIfGiExtPowerLevel      OBJECT-TYPE
    SYNTAX                  Integer32
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION              "Power level: 0-20 representing -5dBm to -15dBm in
                                0.5dBm steps."
::= { tmxIfGiExtEntry 4 }

tmxIfGiExtCarrierFrq      OBJECT-TYPE
    SYNTAX                  Integer32
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION              "47000 kHz - 93000 kHz for the 70 MHz band and
                                104000 khz - 176000 kHz for the 140 MHz band.
                                The frequency must be in steps of 125 kHz."
::= { tmxIfGiExtEntry 5 }

tmxIfGiExtCwMode          OBJECT-TYPE
    SYNTAX                  BITS { modulated(0), unmodulated(1) }
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION              "IF carrier to be unmodulated."
::= { tmxIfGiExtEntry 6 }

tmxIfGiExtMute            OBJECT-TYPE
    SYNTAX                  BITS { notMuted(0), muted(1) }

```

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```

MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "IF carrier to be muted."
 ::= { tmxIfGiExtEntry 7 }

```

```

tmxIfGiExtEntryStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION "Status of this entry."
    ::= { tmxIfGiExtEntry 8 }

```

**

```

tmxStatGroupTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF TmxStatGroupEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The StatGroup Control table. Each row in this
        table represents a create/delete Op command. All
        Ops with the same Time of Action are to be executed
        in the order specified by the message index.
        Program elements within a StatGroup can be
        Constant Bit Rate (CBR) in which case their minBw=maxBw,
        Variable Bit Rate (VBR) in which case their minBw<maxBw,
        and opportunistic in which case they use up only spare Bw
        left unused after all CBR and VBR programs are multiplexed"
    ::= { tmxMediaControl 8 }

```

```

tmxStatGroupEntry OBJECT-TYPE
    SYNTAX      TmxStatGroupEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "StatGroupTable entry"
    INDEX      { ifIndex, tmxStatGroupOpIndex }
    ::= { tmxStatGroupTable 1 }

```

```

TmxStatGroupEntry ::= SEQUENCE {
    tmxStatGroupOpIndex      Integer32,
    tmxStatGroupMsg          BITS,
    tmxStatGroupId           Integer32,
    tmxStatGroupSize         Integer32,
    tmxStatGroupTranscBwPercent Integer32,
    tmxStatGroupMaxInputBw   Integer32,
    tmxStatGroupMaxOutputBw  Integer32,
    tmxStatGroupActionTrigger ActionTriggerType,
    tmxStatGroupActionTime   DateAndTime,
    tmxStatGroupStatus       RowStatus
}

```

**

```

tmxStatGroupOpIndex OBJECT-TYPE
    SYNTAX      Integer32

```

```

MAX-ACCESS          not-accessible
STATUS              current
DESCRIPTION
    "This is used for unique identification and sequencing of
all
    operational configuration messages. The value is the value
of
    tmxOpNum when entry was created and is set by the manager."
 ::= { tmxStatGroupEntry 1 }

tmxStatGroupMsg      OBJECT-TYPE
SYNTAX              BITS { create ( 0 ) , delete ( 1 ) }
MAX-ACCESS          read-create
STATUS              current
DESCRIPTION
    "Each table row constitutes a command message. The message
    type indicates whether the Command type is to either create
    or delete the item described in this row. Any create command
    is further restricted by the Action Trigger Type. Depending
on
    the Action Trigger Type, the command will either be
immediately
    executed, executed at a time specified by Time of Action,
or
    executed when a SPliceImmediateFlag is raised."
 ::= { tmxStatGroupEntry 2 }

tmxStatGroupId       OBJECT-TYPE
SYNTAX              Integer32
MAX-ACCESS          read-create
STATUS              current
DESCRIPTION
    "Group identifier in control multiplex."
 ::= { tmxStatGroupEntry 3 }

tmxStatGroupSize     OBJECT-TYPE
SYNTAX              Integer32
MAX-ACCESS          read-create
STATUS              current
DESCRIPTION
    "Number of members in group."
 ::= { tmxStatGroupEntry 4 }

tmxStatGroupTranscBwPercent OBJECT-TYPE
SYNTAX              Integer32
MAX-ACCESS          read-create
STATUS              current
DESCRIPTION
    "Percentage of overall bandwidth to allocate to multiplex
group,
    if transcoded."
 ::= { tmxStatGroupEntry 5 }

```

```

tmxStatGroupMaxInputBw      OBJECT-TYPE
    SYNTAX                  Integer32
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION
        "Define maximum bandwidth to allocate to this input stat
group,
        if stat group is input."
    ::= { tmxStatGroupEntry 6 }

tmxStatGroupMaxOutputBw     OBJECT-TYPE
    SYNTAX                  Integer32
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION
        "Define maximum bandwidth to allocate to this output stat
group,
        if stat group is input."
    ::= { tmxStatGroupEntry 7 }

tmxStatGroupActionTrigger   OBJECT-TYPE
    SYNTAX                  ActionType
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION
        "Trigger type that will initiate this operation."
    ::= { tmxStatGroupEntry 8 }

tmxStatGroupActionTime      OBJECT-TYPE
    SYNTAX                  DateAndTime
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION
        "If trigger type is a time of action this object contains
the time."
    ::= { tmxStatGroupEntry 9 }

tmxStatGroupStatus          OBJECT-TYPE
    SYNTAX                  RowStatus
    MAX-ACCESS              read-create
    STATUS                  current
    DESCRIPTION
        "Status of this row."
    ::= { tmxStatGroupEntry 10 }

*****
**
tmxProgTable                OBJECT-TYPE
    SYNTAX                  SEQUENCE OF TmxProgEntry
    MAX-ACCESS              not-accessible
    STATUS                  current
    DESCRIPTION
        "The MPEG Service/Program Control table. Each row in this
table represents a create/delete Op command. All

```

Ops with the same Time of Action are to be executed in the order specified by the message index. This table is used to create programs in the output multiplex and to associate programs with possibly external input sources. It is not used to route a complete program from input to output. All routing is done by the Program Component Table."

```
::= { tmxMediaControl 9 }
```

```
tmxProgEntry      OBJECT-TYPE
    SYNTAX          TmxProgEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "Entry into the Program Control table."
    INDEX           { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex }
    ::= { tmxProgTable 1 }
```

```
TmxProgEntry ::= SEQUENCE {
    tmxProgOpIndex      Integer32,
    tmxProgMsg          BITS,
    tmxProgGrpId        Integer32,
    tmxProgEncIPAddr    IPAddress,
    tmxProgEncPort      Integer32,
    tmxProgTmxIPAddr    IPAddress,
    tmxProgTmxPort      Integer32,
    tmxProgProgId       Integer32,
    tmxProgProgName     DisplayString,
    tmxProgPcrPID       Integer32,
    tmxProgGIDS3IQ      BITS,
    tmxProgActionTrigger ActionTriggerType,
    tmxProgActionTime   DateAndTime,
    tmxProgStatus       RowStatus
}
```

```
*****
**
```

```
tmxProgOpIndex      OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This is used for unique identification and sequencing of
all
        operational configuration messages. The value is the value
of
        tmxOpNum when entry was created and is set by the manager."
    ::= { tmxProgEntry 1 }
```

```
tmxProgMsg          OBJECT-TYPE
    SYNTAX          BITS { create ( 0 ) , delete ( 1 ) }
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Each table row constitutes a command message. The message
        type indicates whether the Command type is to either create
```

or delete the item described in this row. Any create command is further restricted by the Action Trigger Type. Depending on the Action Trigger Type, the command will either be immediately executed, executed at a time specified by Time of Action, or executed when a SPlliceImmediateFlag is raised."

```
 ::= { tmxProgEntry 2 }
```

```
tmxProgGrpId      OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Statistical Group identifier in output multiplex,
         if part of a statistical group."
 ::= { tmxProgEntry 3 }
```

```
tmxProgEncIPAddr  OBJECT-TYPE
    SYNTAX          IPAddress
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "If any, IP address of the encoder for this service
         distributed stat mux."
 ::= { tmxProgEntry 4 }
```

```
tmxProgEncPort    OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "If any, Port number of the encoder for this service
         distributed stat mux."
 ::= { tmxProgEntry 5 }
```

```
tmxProgTmxIPAddr  OBJECT-TYPE
    SYNTAX          IPAddress
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "If any, IP address of the TMX for this service for
         distributed stat mux."
 ::= { tmxProgEntry 6 }
```

```
tmxProgTmxPort    OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
```

```

STATUS          current
DESCRIPTION
    "If any, Port number of the TMX for this service for
distributed
    stat mux."
    ::= { tmxProgEntry 7 }

tmxProgProgId    OBJECT-TYPE
SYNTAX          Integer32
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "Output MPEG program (i.e. service) number."
    ::= { tmxProgEntry 8 }

tmxProgProgName  OBJECT-TYPE
SYNTAX          DisplayString
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "Output program name assigned by the user."
    ::= { tmxProgEntry 9 }

tmxProgPcrPID    OBJECT-TYPE
SYNTAX          Integer32
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "PCR PID associated with the program."
    ::= { tmxProgEntry 10 }

tmxProgGIDS3IQ   OBJECT-TYPE
SYNTAX          BITS { splitI ( 0 ) , splitQ ( 1 ) , combined
(2) }
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "Each table row constitutes a command message."
    ::= { tmxProgEntry 11 }

tmxProgActionTrigger OBJECT-TYPE
SYNTAX          ActionType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "Trigger type that will initiate this operation."
    ::= { tmxProgEntry 12 }

tmxProgActionTime OBJECT-TYPE
SYNTAX          DateAndTime
MAX-ACCESS      read-create

```

```

STATUS          current
DESCRIPTION      "If trigger type is a time of action this object contains
the time."
::= { tmxProgEntry 13 }

```

```

tmxProgStatus    OBJECT-TYPE
SYNTAX          RowStatus
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION      "Status of the row."
::= { tmxProgEntry 14 }
*****
**

```

```

tmxProgCompTable OBJECT-TYPE
SYNTAX          SEQUENCE OF TmxProgCompEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION      "The MPEG Service/Program Component Control table. Each row in
this
table represents a create/delete Op command. All
Ops with the same Time of Action are to be executed
in the order specified by the message index."
::= { tmxMediaControl 10 }

```

```

tmxProgCompEntry OBJECT-TYPE
SYNTAX          TmxProgCompEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION      "Entry"
INDEX          { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxProgCompOpIndex }
::= { tmxProgCompTable 1 }

```

```

TmxProgCompEntry ::= SEQUENCE {
tmxProgCompOpIndex      Integer32,
tmxProgCompMsg          BITS,
tmxProgCompTpeId        Integer32,
tmxProgCompSrcId        Integer32,
tmxProgCompPID          Integer32,
tmxProgCompAliasPID     Integer32,
tmxProgCompStreamType   BITS,
tmxProgCompPriority      Integer32,
tmxProgCompTrcMode       BITS,
tmxProgCompEmbeddedPCR  BITS,
tmxProgCompActionTrigger ActionTriggerType,
tmxProgCompActionTime   DateAndTime,
tmxProgCompMinBw         Integer32,
tmxProgCompMaxBw         Integer32,
tmxProgCompStatus        RowStatus
}
*****
**

```



```

tmxProgCompOpIndex  OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This is used for unique identification and sequencing of
all
        operational configuration messages. The value is the value
of
        tmxOpNum when entry was created and is set by the manager."
    ::= { tmxProgCompEntry 1 }

tmxProgCompMsg      OBJECT-TYPE
    SYNTAX          BITS { create ( 0 ) , delete ( 1 ) }
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Each table row constitutes a command message. The message
        type indicates whether the Command type is to either create
        or delete the item described in this row. Any create command
        is further restricted by the Action Trigger Type. Depending
on
        the Action Trigger Type, the command will either be
immediately
        executed, executed at a time specified by Time of Action,
or
        executed when a SPliceImmediateFlag is raised."
    ::= { tmxProgCompEntry 2 }

tmxProgCompTpeId    OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Identifier of the TPE to process this component,
        if any."
    ::= { tmxProgCompEntry 3 }

tmxProgCompSrcId    OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Physical input source identifier (ifIndex)"
    ::= { tmxProgCompEntry 4 }

tmxProgCompPID      OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "MPEG Input PID"
    ::= { tmxProgCompEntry 5 }

```

```

tmxProgCompAliasPID OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "User assigned Component PID number in the output multiplex
        to create or delete."
    ::= { tmxProgCompEntry 6 }

```

```

tmxProgCompStreamType          OBJECT-TYPE
    SYNTAX          BITS { video ( 0 ) , audio ( 1 ) , data ( 2 ) }
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Stream content type of the MPEG component to be
        created or deleted."
    ::= { tmxProgCompEntry 7 }

```

```

tmxProgCompPriority            OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "This is a value between 1 (lowest) and 10 and indicates the
        minimum video quality (quantization level) after which
        opportunistic data can be added to the statistical
        multiplex group. Alternatively, if data within the group
        is guaranteed the this indicates the relative priority
        of the video within the group."
    ::= { tmxProgCompEntry 8 }

```

```

tmxProgCompTrcMode            OBJECT-TYPE
    SYNTAX          BITS { transcode ( 0 ) , passthru ( 1 ) }
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Transcode or passthrough this component."
    ::= { tmxProgCompEntry 9 }

```

```

tmxProgCompEmbeddedPCR        OBJECT-TYPE
    SYNTAX          BITS { enable ( 0 ) , disable ( 1 ) }
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "PCR mode."
    ::= { tmxProgCompEntry 10 }

```

```

tmxProgCompActionTrigger      OBJECT-TYPE
    SYNTAX          ActionTriggerType
    MAX-ACCESS      read-create

```

```

STATUS          current
DESCRIPTION
    "Trigger type that will initiate this operation."
::= { tmxProgCompEntry 11 }

tmxProgCompActionTime OBJECT-TYPE
    SYNTAX          DateAndTime
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "If trigger type is a time of action this object contains
the time."
    ::= { tmxProgCompEntry 12 }

tmxProgCompMinBw OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Minimum bandwidth for program component.
        If minimum = maximum the bandwidth is fixed, i.e.
not
        statistically multiplexed."
    ::= { tmxProgCompEntry 13 }

tmxProgCompMaxBw OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Maximum bandwidth for program component.
        If minimum = maximum the bandwidth is fixed, i.e.
not
        statistically multiplexed."
    ::= { tmxProgCompEntry 14 }

tmxProgCompStatus OBJECT-TYPE
    SYNTAX          RowStatus
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "Status of the row."
    ::= { tmxProgCompEntry 15 }
*****
**
tmxIPDataTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF TmxIPDataEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "The IP Data Component Control table. Each row in this
        table represents a create/delete Op command. All
        Ops with the same Time of Action are to be executed

```

```

        in the order specified by the message index."
    ::= { tmxMediaControl 11 }

tmxIPDataEntry OBJECT-TYPE
    SYNTAX      TmxIPDataEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Entry"
    INDEX       { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex,
tmxIPDataOpIndex }
    ::= { tmxIPDataTable 1 }

TmxIPDataEntry ::= SEQUENCE {
    tmxIPDataOpIndex      Integer32,
    tmxIPDataMsg          BITS,
    tmxIPDataPID          Integer32,
    tmxIPDataDestAddr     IPAddress,
    tmxIPDataFlowCtlType  BITS,
    tmxIPDataTmxFlowCtlServerAddr  IPAddress,
    tmxIPDataTmxFlowCtlServerPort  Integer32,
    tmxIPDataTmxFlowCtlAddr  IPAddress,
    tmxIPDataTmxFlowCtlPort  Integer32,
    tmxIPDataMuxMode       BITS,
    tmxIPDataOutMode       BITS,
    tmxIPDataAvgBitRate    Integer32,
    tmxIPDataAvgTimePeriod Integer32,
    tmxIPDataMinBitRate    Integer32,
    tmxIPDataMaxBitRate    Integer32,
    tmxIPDataActionTrigger ActionTriggerType,
    tmxIPDataActionTime    DateAndTime,
    tmxIPDataSectionLength BITS,
    tmxIPDataStatus        RowStatus
}
*****
**

tmxIPDataOpIndex OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This is used for unique identification and sequencing of
all
        operational configuration messages. The value is the value
of
        tmxOpNum when entry was created and is set by the manager."
    ::= { tmxIPDataEntry 1 }

tmxIPDataMsg OBJECT-TYPE
    SYNTAX      BITS { create ( 0 ) , delete ( 1 ) }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "Each table row constitutes a command message. The message
        type indicates whether the Command type is to either create

```

or delete the item described in this row. Any create command is further restricted by the Action Trigger Type. Depending on the Action Trigger Type, the command will either be immediately executed, executed at a time specified by Time of Action, or executed when a SPlliceImmediateFlag is raised."

```

::= { tmxIPDataEntry 2 }

tmxIPDataPID          OBJECT-TYPE
    SYNTAX              Integer32
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "MPEG PID number in output transport for this data stream.
        There may be multiple IP data route entries for the same
        PID!!!"
    ::= { tmxIPDataEntry 3 }

tmxIPDataDestAddr     OBJECT-TYPE
    SYNTAX              IPAddress
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "IP address of destination host or network that this PID
        will
        route data for."
    ::= { tmxIPDataEntry 4 }

tmxIPDataFlowCtlType   OBJECT-TYPE
    SYNTAX              BITS { none ( 0 ) , smpte-325m ( 1 ) }
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "The type of flow control used by the TMX to throttle the
        data server"
    ::= { tmxIPDataEntry 5 }

tmxIPDataTmxFlowCtlServerAddr OBJECT-TYPE
    SYNTAX              IPAddress
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "Server IP Address for flow control of this data stream."
    ::= { tmxIPDataEntry 6 }

tmxIPDataTmxFlowCtlServerPort OBJECT-TYPE
    SYNTAX              Integer32
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION

```

"Port number of the server's IP port for flow control of this data stream."

::= { tmxIPDataEntry 7 }

tmxIPDataTmxFlowCtlAddr OBJECT-TYPE

SYNTAX IpAddress

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"TMX IP Address for flow control of this data stream."

::= { tmxIPDataEntry 8 }

tmxIPDataTmxFlowCtlPort OBJECT-TYPE

SYNTAX Integer32

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Port number of TMX's IP flow control port for this data stream."

::= { tmxIPDataEntry 9 }

tmxIPDataMuxMode OBJECT-TYPE

SYNTAX BITS { guaranteed (0) , opportunistic (1) }

}

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Data multiplexing mode. Either guaranteed, in which case either

sufficiently much multiplexing bandwidth is allocated or the video quality will be sacrificed in a statistical multiplex; or opportunistic in which case data multiplexing is dependent on spare bandwidth after desired video quality is achieved"

::= { tmxIPDataEntry 10 }

tmxIPDataOutMode OBJECT-TYPE

SYNTAX BITS { atsc (0) , dvb (1) , other (2) }

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"IP data encapsulation."

::= { tmxIPDataEntry 11 }

tmxIPDataAvgBitRate OBJECT-TYPE

SYNTAX Integer32

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Average data bit rate over tmxIPDataAvgTimePeriod, if any."

::= { tmxIPDataEntry 12 }

```

tmxIPDataAvgTimePeriod      OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "Averaging time period in Seconds, if any."
    ::= { tmxIPDataEntry 13 }

tmxIPDataMinBitRate         OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "Minimum guaranteed or desired bit rate over
tmxIPDataAvgTimePeriod,
        if any."
    ::= { tmxIPDataEntry 14 }

tmxIPDataMaxBitRate         OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "Maximum guaranteed or desired bit rate over
tmxIPDataAvgTimePeriod,
        if any."
    ::= { tmxIPDataEntry 15 }

tmxIPDataActionTrigger     OBJECT-TYPE
    SYNTAX      ActionType
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "Trigger type that will initiate this operation."
    ::= { tmxIPDataEntry 16 }

tmxIPDataActionTime        OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "If trigger type is a time of action this object contains
the time."
    ::= { tmxIPDataEntry 17 }

tmxIPDataSectionLength     OBJECT-TYPE
    SYNTAX      BITS { len4096(0), len1024(1) }
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "Maximum length of DSM-CC sections."

```

```

        ::= { tmxIPDataEntry 18 }

tmxIPDataStatus          OBJECT-TYPE
    SYNTAX                RowStatus
    MAX-ACCESS             read-create
    STATUS                 current
    DESCRIPTION            "Status of the row."
    ::= { tmxIPDataEntry 19 }

*****
**
tmxAsyncDataTable OBJECT-TYPE
    SYNTAX                SEQUENCE OF TmxAsyncDataEntry
    MAX-ACCESS             not-accessible
    STATUS                 current
    DESCRIPTION            "The RS-232/RS-422 Data Component Control table. Each row in this
                           table represents a create/delete Op command. All
                           Ops with the same Time of Action are to be executed
                           in the order specified by the message index."
    ::= { tmxMediaControl 12 }

tmxAsyncDataEntry        OBJECT-TYPE
    SYNTAX                TmxAsyncDataEntry
    MAX-ACCESS             not-accessible
    STATUS                 current
    DESCRIPTION            "Entry"
    INDEX                  { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxAsyncDataOpIndex }
    ::= { tmxAsyncDataTable 1 }

TmxAsyncDataEntry ::= SEQUENCE {
    tmxAsyncDataOpIndex      Integer32,
    tmxAsyncDataMsg          BITS,
    tmxAsyncDataSrcId        Integer32,
    tmxAsyncDataPID          Integer32,
    tmxAsyncDataBaudRate     Integer32,
    tmxAsyncDataParity       Integer32,
    tmxAsyncDataBits         Integer32,
    tmxAsyncDataStopBits     Integer32,
    tmxAsyncDataFlowControl  BITS,
    tmxAsyncDataMuxMode       BITS,
    tmxAsyncDataOutMode       BITS,
    tmxAsyncDataAvgBitRate    Integer32,
    tmxAsyncDataAvgTimePeriod Integer32,
    tmxAsyncDataMinBitRate    Integer32,
    tmxAsyncDataMaxBitRate    Integer32,
    tmxAsyncDataActionTrigger ActionTriggerType,
    tmxAsyncDataActionTime    DateAndTime,
    tmxAsyncDataStatus        RowStatus
}
*****
**

```


tmxAsyncDataOpIndex	OBJECT-TYPE
SYNTAX	Integer32
MAX-ACCESS	not-accessible
STATUS	current
DESCRIPTION	"This is used for unique identification and sequencing of
all	operational configuration messages. The value is the value
of	tmxOpNum when entry was created and is set by the manager."
	::= { tmxAsyncDataEntry 1 }

tmxAsyncDataMsg	OBJECT-TYPE
SYNTAX	BITS { create (0) , delete (1) }
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	"Each table row constitutes a command message. The message
	type indicates whether the Command type is to either create
	or delete the item described in this row. Any create command
	is further restricted by the Action Trigger Type. Depending
on	the Action Trigger Type, the command will either be
immediately	executed, executed at a time specified by Time of Action,
or	executed when a SPlliceImmediateFlag is raised."
	::= { tmxAsyncDataEntry 2 }

tmxAsyncDataSrcId	OBJECT-TYPE
SYNTAX	Integer32
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	"Physical input identifier (ifIndex)."
	::= { tmxAsyncDataEntry 3 }

tmxAsyncDataPID	OBJECT-TYPE
SYNTAX	Integer32
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	"MPEG PID number in output multiplex for this data
stream."	
	::= { tmxAsyncDataEntry 4 }

tmxAsyncDataBaudRate	OBJECT-TYPE
SYNTAX	Integer32
MAX-ACCESS	read-create
STATUS	current
DESCRIPTION	"RS-232 baud rate setting, if any."
	::= { tmxAsyncDataEntry 5 }

```

tmxAsyncDataParity      OBJECT-TYPE
    SYNTAX               Integer32
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION
        "RS-232 parity, if any."
    ::= { tmxAsyncDataEntry 6 }

tmxAsyncDataBits        OBJECT-TYPE
    SYNTAX               Integer32
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION
        "RS-232 number of data bits, if any."
    ::= { tmxAsyncDataEntry 7 }

tmxAsyncDataStopBits    OBJECT-TYPE
    SYNTAX               Integer32
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION
        "RS-232, number of stop bits, if any."
    ::= { tmxAsyncDataEntry 8 }

tmxAsyncDataFlowControl OBJECT-TYPE
    SYNTAX               BITS { xonxoff ( 0 ) , hw ( 1 ) , none ( 2 ) }
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION
        "RS-232 flow control, if any."
    ::= { tmxAsyncDataEntry 9 }
}

tmxAsyncDataMuxMode     OBJECT-TYPE
    SYNTAX               BITS { guaranteed ( 0 ) , opportunistic ( 1 ) }
    MAX-ACCESS            read-create
    STATUS                current
    DESCRIPTION
        "Data multiplexing mode. Either guaranteed, in which case
either
        sufficiently much multiplexing bandwidth is allocated or the
        video quality will be sacrificed in a statistical multiplex;
        or opportunistic in which case data multiplexing is
dependent
        on spare bandwidth after desired video quality is achieved"
    ::= { tmxAsyncDataEntry 10 }

tmxAsyncDataOutMode     OBJECT-TYPE
    SYNTAX               BITS { atsc ( 0 ) , dvb ( 1 ) }

```

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```

MAX-ACCESS          read-create
STATUS              current
DESCRIPTION          "Data encapsulation on output."
 ::= { tmxAsyncDataEntry 11 }

tmxAsyncDataAvgBitRate OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION      "Average data bit rate over
tmxAsyncDataAvgTimePeriod, if any."
 ::= { tmxAsyncDataEntry 12 }

tmxAsyncDataAvgTimePeriod OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION      "Averaging time period in Seconds, if any."
 ::= { tmxAsyncDataEntry 13 }

tmxAsyncDataMinBitRate OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION      "Minimum guaranteed or desired bit rate over
tmxAsyncDataAvgTimePeriod, if any."
 ::= { tmxAsyncDataEntry 14 }

tmxAsyncDataMaxBitRate OBJECT-TYPE
    SYNTAX          Integer32
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION      "Maximum guaranteed or desired bit rate over
tmxAsyncDataAvgTimePeriod, if any."
 ::= { tmxAsyncDataEntry 15 }

tmxAsyncDataActionTrigger OBJECT-TYPE
    SYNTAX          ActionTriggerType
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION      "Trigger type that will initiate this operation."
 ::= { tmxAsyncDataEntry 16 }

tmxAsyncDataActionTime OBJECT-TYPE
    SYNTAX          DateAndTime

```

```

MAX-ACCESS      read-create
STATUS          current
DESCRIPTION      "If trigger type is a time of action this object
contains the time."
::= { tmxAsyncDataEntry 17 }

```

```

tmxAsyncDataStatus OBJECT-TYPE
SYNTAX             RowStatus
MAX-ACCESS         read-create
STATUS             current
DESCRIPTION        "Status of the row."
::= { tmxAsyncDataEntry 18 }

```

```

*****
**

```

```

tmxCarouselTable OBJECT-TYPE
SYNTAX           SEQUENCE OF TmxCarouselEntry
MAX-ACCESS       not-accessible
STATUS           current
DESCRIPTION      "The Carousel Control table. Each row in this
                  table represents a create/delete Op command. All
                  Ops with the same Time of Action are to be executed
                  in the order specified by the message index."
::= { tmxMediaControl 13 }

```

```

tmxCarouselEntry OBJECT-TYPE
SYNTAX           TmxCarouselEntry
MAX-ACCESS       not-accessible
STATUS           current
DESCRIPTION      "Entry"
INDEX            { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxCarouselOpIndex }
::= { tmxCarouselTable 1 }

```

```

TmxCarouselEntry ::= SEQUENCE {
    tmxCarouselOpIndex      Integer32,
    tmxCarouselMsg          BITS,
    tmxCarouselPID          Integer32,
    tmxCarouselOutStandard  BITS,
    tmxCarouselRepetitionRate Integer32,
    tmxCarouselLoadData     OCTET STRING,
    tmxCarouselActionTrigger ActionTriggerType,
    tmxCarouselActionTime   DateAndTime,
    tmxCarouselOnDemand     BITS,
    tmxCarouselStatus       RowStatus
}

```

```

*****
**

```

```

tmxCarouselOpIndex OBJECT-TYPE
SYNTAX             Integer32

```

```

MAX-ACCESS          not-accessible
STATUS              current
DESCRIPTION
    "This is used for unique identification and sequencing of
all
    operational configuration messages. The value is the value
of
    tmxOpNum when entry was created and is set by the manager."
 ::= { tmxCarouselEntry 1 }

tmxCarouselMsg          OBJECT-TYPE
SYNTAX                BITS { create ( 0 ) , delete ( 1 ) }
MAX-ACCESS            read-create
STATUS                current
DESCRIPTION
    "Each table row constitutes a command message. The message
command
    type indicates whether the Command type is to either create
    or delete the item described in this row. Any create
on
    is further restricted by the Action Trigger Type. Depending
    the Action Trigger Type, the command will either be
immediately
    executed, executed at a time specified by Time of Action,
or
    executed when a SPlliceImmediateFlag is raised."
 ::= { tmxCarouselEntry 2 }

tmxCarouselPID          OBJECT-TYPE
SYNTAX                Integer32
MAX-ACCESS            read-create
STATUS                current
DESCRIPTION
    "MPEG PID number in output multiplex."
 ::= { tmxCarouselEntry 3 }

tmxCarouselOutStandard  OBJECT-TYPE
SYNTAX                BITS { atsc ( 0 ) , dvb ( 1 ) }
MAX-ACCESS            read-create
STATUS                current
DESCRIPTION
    "Data encapsulation on output, if any."
 ::= { tmxCarouselEntry 4 }

tmxCarouselRepetitionRate OBJECT-TYPE
SYNTAX                Integer32
MAX-ACCESS            read-create
STATUS                current
DESCRIPTION
    "Repetition rate of the data in milliseconds."
 ::= { tmxCarouselEntry 5 }

tmxCarouselLoadData     OBJECT-TYPE

```

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```

SYNTAX          OCTET STRING
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "File name on server or if LoadHost=NULL, this
                is the data itself that is to be put onto the
                Carousel."
 ::= { tmxCarouselEntry 6 }

tmxCarouselActionTrigger OBJECT-TYPE
SYNTAX          ActionTypeType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Trigger type that will initiate this operation."
 ::= { tmxCarouselEntry 7 }

tmxCarouselActionTime OBJECT-TYPE
SYNTAX          DateAndTime
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "If trigger type is a time of action this object
contains the time."
 ::= { tmxCarouselEntry 8 }

tmxCarouselOnDemand OBJECT-TYPE
SYNTAX          BITS { disabled(0), enabled(1) }
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Switch for on-demand table generation"
 ::= { tmxCarouselEntry 9 }

tmxCarouselStatus OBJECT-TYPE
SYNTAX          RowStatus
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Status of the row."
 ::= { tmxCarouselEntry 10 }

*****
**
tmxFifoTable OBJECT-TYPE
SYNTAX          SEQUENCE OF TmxFifoEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "The FIFO Control table. Each row in this
                table represents a create/delete Op command. All
                Ops with the same Time of Action are to be executed
                in the order specified by the message index."
 ::= { tmxMediaControl 14 }

tmxFifoEntry OBJECT-TYPE
SYNTAX          TmxFifoEntry

```

```

MAX-ACCESS          not-accessible
STATUS              current
DESCRIPTION
    "Entry"
INDEX               { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex ,
tmxFifoOpIndex }
    ::= { tmxFifoTable 1 }

TmxFifoEntry ::= SEQUENCE {
    tmxFifoOpIndex      Integer32,
    tmxFifoMsg          BITS,
    tmxFifoPID          Integer32,
    tmxFifoOutStandard  BITS,
    tmxFifoAvgBitRate   Integer32,
    tmxFifoAvgTimePeriod Integer32,
    tmxFifoMinBitRate   Integer32,
    tmxFifoMaxBitRate   Integer32,
    tmxFifoLoadTime     Integer32,
    tmxFifoLoadType     BITS,
    tmxFifoLoadHost     IpAddress,
    tmxFifoFileName     DisplayString,
    tmxFifoLoadDataType BITS,
    tmxFifoActionTrigger ActionType,
    tmxFifoActionTime   DateAndTime,
    tmxFifoOnDemand     BITS,
    tmxFifoStatus       RowStatus
}
*****
**

tmxFifoOpIndex      OBJECT-TYPE
    SYNTAX           Integer32
    MAX-ACCESS       not-accessible
    STATUS           current
    DESCRIPTION
        "This is used for unique identification and sequencing of
all
operational configuration messages. The value is the value
of
tmxOpNum when entry was created and is set by the manager."
    ::= { tmxFifoEntry 1 }

tmxFifoMsg          OBJECT-TYPE
    SYNTAX           BITS { create ( 0 ) , delete ( 1 ) }
    MAX-ACCESS       read-create
    STATUS           current
    DESCRIPTION
        "Each table row constitutes a command message. The message
type indicates whether the Command type is to either create
or delete the item described in this row. Any create
command
is further restricted by the Action Trigger Type. Depending
on
the Action Trigger Type, the command will either be
immediately
executed, executed at a time specified by Time of Action,
or

```

```

        executed when a SPliceImmediateFlag is raised."
    ::= { tmxFifoEntry 2 }

tmxFifoPID                                OBJECT-TYPE
    SYNTAX                                Integer32
    MAX-ACCESS                            read-create
    STATUS                                current
    DESCRIPTION
        "MPEG PID number in output multiplex."
    ::= { tmxFifoEntry 3 }

tmxFifoOutStandard                        OBJECT-TYPE
    SYNTAX                                BITS { atsc ( 0 ) , dvb ( 1 ) }
    MAX-ACCESS                            read-create
    STATUS                                current
    DESCRIPTION
        "Data encapsulation on output, if any."
    ::= { tmxFifoEntry 4 }

tmxFifoAvgBitRate                        OBJECT-TYPE
    SYNTAX                                Integer32
    MAX-ACCESS                            read-create
    STATUS                                current
    DESCRIPTION
        "Average data bit rate over tmxFifoAvgTimePeriod, if
any."
    ::= { tmxFifoEntry 5 }

tmxFifoAvgTimePeriod                    OBJECT-TYPE
    SYNTAX                                Integer32
    MAX-ACCESS                            read-create
    STATUS                                current
    DESCRIPTION
        "Averaging time period in Seconds, if any."
    ::= { tmxFifoEntry 6 }

tmxFifoMinBitRate                        OBJECT-TYPE
    SYNTAX                                Integer32
    MAX-ACCESS                            read-create
    STATUS                                current
    DESCRIPTION
        "Minimum guaranteed or desired bit rate over
        tmxFifoAvgTimePeriod, if any."
    ::= { tmxFifoEntry 7 }

tmxFifoMaxBitRate                        OBJECT-TYPE
    SYNTAX                                Integer32
    MAX-ACCESS                            read-create
    STATUS                                current
    DESCRIPTION
        "Maximum guaranteed or desired bit rate over

```



```

tmxFifoAvgTimePeriod, if any."
 ::= { tmxFifoEntry 8 }

tmxFifoLoadTime          OBJECT-TYPE
    SYNTAX                Integer32
    MAX-ACCESS             read-create
    STATUS                 current
    DESCRIPTION            "Time at which to load the file from server, if any."
 ::= { tmxFifoEntry 9 }

tmxFifoLoadType          OBJECT-TYPE
    SYNTAX                BITS { tftp ( 0 ) , ftp ( 1 ) , nfs ( 2 ) ,
snmpdata ( 3 ) }
    MAX-ACCESS             read-create
    STATUS                 current
    DESCRIPTION            "FIFO load protocol."
 ::= { tmxFifoEntry 10 }

tmxFifoLoadHost          OBJECT-TYPE
    SYNTAX                IPAddress
    MAX-ACCESS             read-create
    STATUS                 current
    DESCRIPTION            "IP address of server."
 ::= { tmxFifoEntry 11 }

tmxFifoFileName          OBJECT-TYPE
    SYNTAX                DisplayString
    MAX-ACCESS             read-create
    STATUS                 current
    DESCRIPTION            "File name on server."
 ::= { tmxFifoEntry 12 }

tmxFifoLoadDataType      OBJECT-TYPE
    SYNTAX                BITS { data ( 0 ) , dsmcc ( 1 ) ,
prepacketized ( 2 ) }
    MAX-ACCESS             read-create
    STATUS                 current
    DESCRIPTION            "Format of data to be put onto the FIFO."
 ::= { tmxFifoEntry 13 }

tmxFifoActionTrigger     OBJECT-TYPE
    SYNTAX                ActionTriggerType
    MAX-ACCESS             read-create
    STATUS                 current
    DESCRIPTION            "Trigger type that will initiate this operation."
 ::= { tmxFifoEntry 14 }

```

```

tmxFifoActionTime      OBJECT-TYPE
    SYNTAX              DateAndTime
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION
        "If trigger type is a time of action this object contains
the time."
    ::= { tmxFifoEntry 15 }

tmxFifoOnDemand        OBJECT-TYPE
    SYNTAX              BITS { disabled(0), enabled(1) }
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION         "Switch for on-demand table generation"
    ::= { tmxFifoEntry 16 }

tmxFifoStatus          OBJECT-TYPE
    SYNTAX              RowStatus
    MAX-ACCESS          read-create
    STATUS              current
    DESCRIPTION         "Status of the row."
    ::= { tmxFifoEntry 17 }
*****
**
tmxProgInsertTable     OBJECT-TYPE
    SYNTAX              SEQUENCE OF TmxProgInsertEntry
    MAX-ACCESS          not-accessible
    STATUS              current
    DESCRIPTION         "Table to control TMX's digital program insertion (Ads,
NVOD)
                        and splicing. Each row in this
                        table represents a create/delete Op command. All
                        Ops with the same Time of Action are to be executed
                        in the order specified by the message index."
    ::= { tmxMediaControl 15 }

tmxProgInsertEntry     OBJECT-TYPE
    SYNTAX              TmxProgInsertEntry
    MAX-ACCESS          not-accessible
    STATUS              current
    DESCRIPTION         "Entry"
    INDEX              { ifIndex, tmxStatGroupOpIndex, tmxProgOpIndex,
tmxProgInsertOpIndex }
    ::= { tmxProgInsertTable 1 }

TmxProgInsertEntry ::= SEQUENCE {
    tmxProgInsertOpIndex      Integer32,
    tmxProgInsertMsg          BITS,
    tmxProgInsertProgName     DisplayString,
    tmxProgInsertSplicerName  DisplayString,
    tmxProgInsertSplicerType  BITS,
    tmxProgInsertServerAddr   IpAddress,

```

```

tmxProgInsertServerPort      Integer32,
tmxProgInsertAdSrcId         Integer32,
tmxProgInsertTmxAddr         IPAddress,
tmxProgInsertTmxPort         Integer32,
tmxProgInsertActionTrigger   ActionTriggerType,
tmxProgInsertActionTime      DateAndTime,
tmxProgInsertStatus          RowStatus
}
*****
**

tmxProgInsertOpIndex          OBJECT-TYPE
    SYNTAX                     Integer32
    MAX-ACCESS                 not-accessible
    STATUS                     current
    DESCRIPTION
        "This is used for unique identification and sequencing of
all
        operational configuration messages. The value is the value
of
        tmxOpNum when entry was created and is set by the manager."
    ::= { tmxProgInsertEntry 1 }

tmxProgInsertMsg              OBJECT-TYPE
    SYNTAX                     BITS { create ( 0 ) , delete ( 1 ) }
    MAX-ACCESS                 read-create
    STATUS                     current
    DESCRIPTION
        "Each table row constitutes a command message. The message
command
        type indicates whether the Command type is to either create
        or delete the item described in this row. Any create
on
        is further restricted by the Action Trigger Type. Depending
        the Action Trigger Type, the command will either be
immediately
        executed, executed at a time specified by Time of Action,
or
        executed when a SPliceImmediateFlag is raised."
    ::= { tmxProgInsertEntry 2 }

tmxProgInsertProgName         OBJECT-TYPE
    SYNTAX                     DisplayString
    MAX-ACCESS                 read-create
    STATUS                     current
    DESCRIPTION
        "User assigned program name of the program being
spliced into."
    ::= { tmxProgInsertEntry 3 }

tmxProgInsertSplicerName      OBJECT-TYPE
    SYNTAX                     DisplayString
    MAX-ACCESS                 read-create
    STATUS                     current

```

```

DESCRIPTION
    "Name of the splicer if more then one in TMX (as in
DVS standard)."
```

```

    ::= { tmxProgInsertEntry 4 }

tmxProgInsertSplicerType OBJECT-TYPE
    SYNTAX BITS { adstreaminsert (0) , nvodstreaminsert
(1),
                                actvstreaminsert(2) }
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "Type of splicer."
    ::= { tmxProgInsertEntry 5 }

tmxProgInsertServerAddr OBJECT-TYPE
    SYNTAX IPAddress
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "IP address of server for this stream insertion for
DVS 380 API."
    ::= { tmxProgInsertEntry 6 }

tmxProgInsertServerPort OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "Server TCP port number for control of this stream
insertion
for DVS 380 API."
    ::= { tmxProgInsertEntry 7 }

tmxProgInsertAdSrcId OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "Physical input identifier (ifIndex) of the ad/NVOD
stream."
    ::= { tmxProgInsertEntry 8 }

tmxProgInsertTmxAddr OBJECT-TYPE
    SYNTAX IPAddress
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "IP address of TMX for this stream insertion for DVS
380 API."
    ::= { tmxProgInsertEntry 9 }

```

```

tmxProgInsertTmxPort          OBJECT-TYPE
    SYNTAX                     Integer32
    MAX-ACCESS                 read-create
    STATUS                     current
    DESCRIPTION                 "TMX TCP port number for control of this stream
insertion
                                for DVS 380 API."
    ::= { tmxProgInsertEntry 10 }

tmxProgInsertActionTrigger OBJECT-TYPE
    SYNTAX                     ActionType
    MAX-ACCESS                 read-create
    STATUS                     current
    DESCRIPTION                 "Trigger type that will initiate this operation."
    ::= { tmxProgInsertEntry 11 }

tmxProgInsertActionTime       OBJECT-TYPE
    SYNTAX                     DateAndTime
    MAX-ACCESS                 read-create
    STATUS                     current
    DESCRIPTION                 "If trigger type is a time of action this object contains
the time."
    ::= { tmxProgInsertEntry 12 }

tmxProgInsertStatus           OBJECT-TYPE
    SYNTAX                     RowStatus
    MAX-ACCESS                 read-create
    STATUS                     current
    DESCRIPTION                 "Status of the row."
    ::= { tmxProgInsertEntry 13 }

-- tmxMediaMonitor tables enable monitoring of MPEG input/output information.
-- They consist of:
--         tmxInputPIDTable for input rate monitoring per PID
--         tmxOutputPIDTable for output rate monitoring per PID
--         tmxPsiSiTable for MPEG Table monitoring per PID
*****
**
tmxInputPIDTable.. OBJECT-TYPE
    SYNTAX                     SEQUENCE OF TmxInputPIDEntry
    MAX-ACCESS                 not-accessible
    STATUS                     current
    DESCRIPTION                 "Table with input PID statistics."
    ::= { tmxMediaMonitor 1 }

tmxInputPIDEntry             OBJECT-TYPE
    SYNTAX                     TmxInputPIDEntry
    MAX-ACCESS                 not-accessible
    STATUS                     current

```

```

DESCRIPTION
    "Entry"
INDEX      { ifIndex, tmxInputPIDId  }
::= { tmxInputPIDTable 1 }

TmxInputPIDEntry ::= SEQUENCE {
    tmxInputPIDId      Integer32,
    tmxInputPIDBitRate Integer32,
    tmxInputPIDEntryStatus RowStatus
}
*****
**
tmxInputPIDId      OBJECT-TYPE
SYNTAX             Integer32
MAX-ACCESS         read-only
STATUS             current
DESCRIPTION
    "Component PID with stream type."
::= { tmxInputPIDEntry 1 }

tmxInputPIDBitRate OBJECT-TYPE
SYNTAX             Integer32
MAX-ACCESS         read-only
STATUS             current
DESCRIPTION
    "Bit rate in bps."
::= { tmxInputPIDEntry 2 }

tmxInputPIDEntryStatus OBJECT-TYPE
SYNTAX             RowStatus
MAX-ACCESS         read-create
STATUS             current
DESCRIPTION
    "Status of this entry."
::= { tmxInputPIDEntry 3 }
*****
**
tmxOutputPIDTable OBJECT-TYPE
SYNTAX             SEQUENCE OF TmxOutputPIDEntry
MAX-ACCESS         not-accessible
STATUS             current
DESCRIPTION
    "Table with output PID statistics."
::= { tmxMediaMonitor 2 }

tmxOutputPIDEntry OBJECT-TYPE
SYNTAX             TmxOutputPIDEntry
MAX-ACCESS         not-accessible
STATUS             current
DESCRIPTION
    "Entry"
INDEX      { ifIndex, tmxOutputPIDId  }
::= { tmxOutputPIDTable 1 }

TmxOutputPIDEntry ::= SEQUENCE {
    tmxOutputPIDId      Integer32,

```

```

tmxOutputPIDBitRate          Integer32,
tmxOutputPIDMinBitRate       Integer32,
tmxOutputPIDMaxBitRate       Integer32,
tmxOutputPIDFrameRate        Integer32,
tmxOutputPIDResolution       Integer32,
tmxOutputPIDBFrames          Integer32,
tmxOutputPIDFilmMode         Integer32,
tmxOutputPIDEntryStatus      RowStatus
}
*****
**

tmxOutputPIDId               OBJECT-TYPE
    SYNTAX                    Integer32
    MAX-ACCESS                read-only
    STATUS                    current
    DESCRIPTION
        "Component PID with stream type."
    ::= { tmxOutputPIDEntry 1 }

tmxOutputPIDBitRate          OBJECT-TYPE
    SYNTAX                    Integer32
    MAX-ACCESS                read-only
    STATUS                    current
    DESCRIPTION
        "Bit rate in bps."
    ::= { tmxOutputPIDEntry 2 }

tmxOutputPIDMinBitRate       OBJECT-TYPE
    SYNTAX                    Integer32
    MAX-ACCESS                read-only
    STATUS                    current
    DESCRIPTION
        "Min Bit rate in bps."
    ::= { tmxOutputPIDEntry 3 }

tmxOutputPIDMaxBitRate       OBJECT-TYPE
    SYNTAX                    Integer32
    MAX-ACCESS                read-only
    STATUS                    current
    DESCRIPTION
        "Max Bit rate in bps."
    ::= { tmxOutputPIDEntry 4 }

tmxOutputPIDFrameRate        OBJECT-TYPE
    SYNTAX                    Integer32
    MAX-ACCESS                read-only
    STATUS                    current
    DESCRIPTION
        "Frame rate if the PID is a transcoded video PID."
    ::= { tmxOutputPIDEntry 5 }

```

```

tmxOutputPIDResolution      OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION  "Number of Macroblocks per Second if PID is a
transcoded video PID."
    ::= { tmxOutputPIDEntry 6 }

tmxOutputPIDBFrames         OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION  "Average ratio of B frames to I and P frames if PID
is a
transcoded video PID."
    ::= { tmxOutputPIDEntry 7 }

tmxOutputPIDFilmMode        OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION  "Film mode status if PID is a transcoded video PID."
    ::= { tmxOutputPIDEntry 8 }

tmxOutputPIDEntryStatus     OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION  "Status of this entry."
    ::= { tmxOutputPIDEntry 9 }

*****
**
tmxPsiSiTable                OBJECT-TYPE
    SYNTAX      SEQUENCE OF TmxPsiSiEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION  "Table of all input transport streams."
    ::= { tmxMediaMonitor 3 }

tmxPsiSiEntry OBJECT-TYPE
    SYNTAX      TmxPsiSiEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION  "Entry"
    INDEX      { ifIndex, tmxPsiSiPidNum, tmxPsiSiTableId,
tmxPsiSiCurrNext}
    ::= { tmxPsiSiTable 1 }

```



```

TmxPsiSiEntry ::= SEQUENCE {
    tmxPsiSiPidNum      Integer32,
    tmxPsiSiTableId     Integer32,
    tmxPsiSiCurrNext    Integer32,
    tmxPsiSiTableInfo   OCTET STRING,
    tmxPsiSiVersion     Integer32,
    tmxPsiSiEntryStatus RowStatus
}
*****
**

tmxPsiSiPidNum      OBJECT-TYPE
    SYNTAX           Integer32
    MAX-ACCESS       not-accessible
    STATUS           current
    DESCRIPTION
        "Transport Stream PID number"
    ::= { tmxPsiSiEntry 1 }

tmxPsiSiTableId     OBJECT-TYPE
    SYNTAX           Integer32
    MAX-ACCESS       not-accessible
    STATUS           current
    DESCRIPTION
        "Transport Stream Table Id"
    ::= { tmxPsiSiEntry 2 }

tmxPsiSiCurrNext    OBJECT-TYPE
    SYNTAX           Integer32
    MAX-ACCESS       not-accessible
    STATUS           current
    DESCRIPTION
        "MPEG Table currnet next indicator."
    ::= { tmxPsiSiEntry 3 }

tmxPsiSiTableInfo   OBJECT-TYPE
    SYNTAX           OCTET STRING
    MAX-ACCESS       read-only
    STATUS           current
    DESCRIPTION
        "Transport Stream Table."
    ::= { tmxPsiSiEntry 4 }

tmxPsiSiVersion     OBJECT-TYPE
    SYNTAX           Integer32
    MAX-ACCESS       read-only
    STATUS           current
    DESCRIPTION
        "Table version for this transport stream"
    ::= { tmxPsiSiEntry 5 }

tmxPsiSiEntryStatus OBJECT-TYPE
    SYNTAX           RowStatus
    MAX-ACCESS       read-create
    STATUS           current
    DESCRIPTION
        "Status of this entry."

```

```

        ::= { tmxPsiSiEntry 6 }

tmxMuxMemoryTable      OBJECT-TYPE
    SYNTAX              SEQUENCE OF TmxMuxMemoryEntry
    MAX-ACCESS           not-accessible
    STATUS               current
    DESCRIPTION
        "Table indicating the maximum contiguous block of memory
available for carousels."
    ::= { tmxMediaMonitor 4 }

tmxMuxMemoryEntry      OBJECT-TYPE
    SYNTAX              TmxMuxMemoryEntry
    MAX-ACCESS           not-accessible
    STATUS               current
    DESCRIPTION
        "Entry"
    INDEX               {ifIndex}
    ::= { tmxMuxMemoryTable 1 }

TmxMuxMemoryEntry ::= SEQUENCE {
    tmxMuxMemorySize      Integer32,
    tmxMuxMemoryEntryStatus RowStatus
}

tmxMuxMemorySize      OBJECT-TYPE
    SYNTAX              Integer32
    MAX-ACCESS           read-only
    STATUS               current
    DESCRIPTION
        "The maximum byte size currently available."
    ::= { tmxMuxMemoryEntry 1 }

tmxMuxMemoryEntryStatus OBJECT-TYPE
    SYNTAX              RowStatus
    MAX-ACCESS           read-create
    STATUS               current
    DESCRIPTION
        "Status of this entry."
    ::= { tmxMuxMemoryEntry 2 }

```

END

[0077] While the present invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but is intended to encompass the various modifications and equivalent arrangements included within the spirit and scope of the appended claims. With respect to the above description, for example, it is to be realized that the optimum implementation, function and manner of operation, assembly and use, are deemed readily apparent to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the appended claims. Therefore, the foregoing is considered to be an illustrative, not exhaustive, description of the principles of the present invention.

What is claimed is:

1. A control system that uses SNMP to remotely control broadband communications hardware via a network, the communications hardware comprising a plurality of processor boards that perform content stream manipulation and configuration task firmware for configuring and controlling the processor boards, the control system comprising:

a user interface for presenting information to a control system operator and for receiving input from the operator;

an element manager communicatively linking the user interface to the network, the element manager packaging the operator input as SNMP messages and sending the messages to the SNMP agent via the network, the element manager also receiving SNMP messages from the SNMP agent via the network and providing information contained therein to the user interface for presentation to the operator; and

an SNMP agent communicatively linking the configuration task firmware and the network, the SNMP agent comprising means for brokering information exchanged between the element manager and the configuration task firmware.

2. The control system of claim 1 wherein the SNMP agent translates SNMP messages received from the element manager via the network into a form that can be understood by the configuration task firmware and packages information in to SNMP messages for receipt by the element manager via the network.

3. The control system of claim 1 wherein the content streams are MPEG 2 data streams, wherein the network is an Ethernet network and wherein the communications hardware is a TMX chassis.

4. The control system of claim 1 wherein the user interface is a graphical user interface comprising a common browser.
5. The control system of claim 1 wherein the SNMP agent populates MIB tables with system data received from the configuration task firmware and wherein the element manager reads the system data from the MIB tables and provides it to the user interface for display.
6. The control system of claim 1 wherein the element manager populates MIB tables with operator input received from the user interface and wherein the SNMP agent reads the operator input from the MIB tables and provides it as instructions to the configuration task firmware.
7. The control system of claim 1 wherein the element manager runs on a personal computer that is communicatively linked to the network and wherein the element manager has been uploaded to the computer as a java applet via the network during a set-up phase.
8. A method of remotely controlling broadband communications hardware via a network, the communications hardware comprising a plurality of processor boards for manipulating content streams and configuration task firmware for configuring and controlling the processor boards, the method comprising:
 - receiving content stream control commands from the operator at a first location on the network;
 - packaging the control commands as SNMP messages;
 - sending the SNMP messages across the network to a second location physically remote from the first location;
 - receiving the SNMP messages at the second location;

translating the received SNMP messages into control commands that the configuration task firmware can understand; and
sending the translated commands to the configuration task firmware for execution.

9. The method of claim 8 wherein the content streams are MPEG 2 data streams, wherein the network is an Ethernet network and wherein the communications hardware is a TMX chassis.

10. The method of claim 8 wherein receiving content stream control commands comprises receiving content stream drag and drop commands from a graphical user interface that comprises a browser.

11. The method of claim 10 wherein packaging the control commands as SNMP messages comprises populating MIB tables with content stream attributes resulting from the drag and drop commands.

12. The method of claim 10 further comprising
polling the communications hardware for system status data;
populating MIB tables with the system status data;
reading the system status data from the MIB tables; and
displaying the system status data on the graphical user interface.

13. The method of claim 10 further comprising
polling the communications hardware for content stream attribute data;
populating MIB tables with the content stream attribute data;
reading the content stream attribute data from the MIB tables; and
displaying the system content stream data on the graphical user interface.

14. The method of claim 10 further comprising
- polling the communications processor board attribute data comprising data relating to the identity, structure and operational status of the processor boards;
 - populating MIB tables with the processor board attribute data;
 - reading the processor board attribute data from the MIB tables; and
 - displaying the processor board attribute data on the graphical user interface.
15. A method of remotely enabling an output port of a TMX chassis via a network, the TMX chassis having a multiplexer, a quantization level processor and an input processor for manipulating content streams passing therethrough to the output port, the method comprising:
- receiving a port enable command from an operator at a first location on the network;
 - sending the port enable command across the network to the TMX chassis at a second location physically remote from the first location; and
 - responsive to receipt of the port enable command,
 - activating the targeted multiplexer first,
 - activating the quantization level processor second; and
 - activating the input processor third to thereby permit a content stream to pass to the output port.

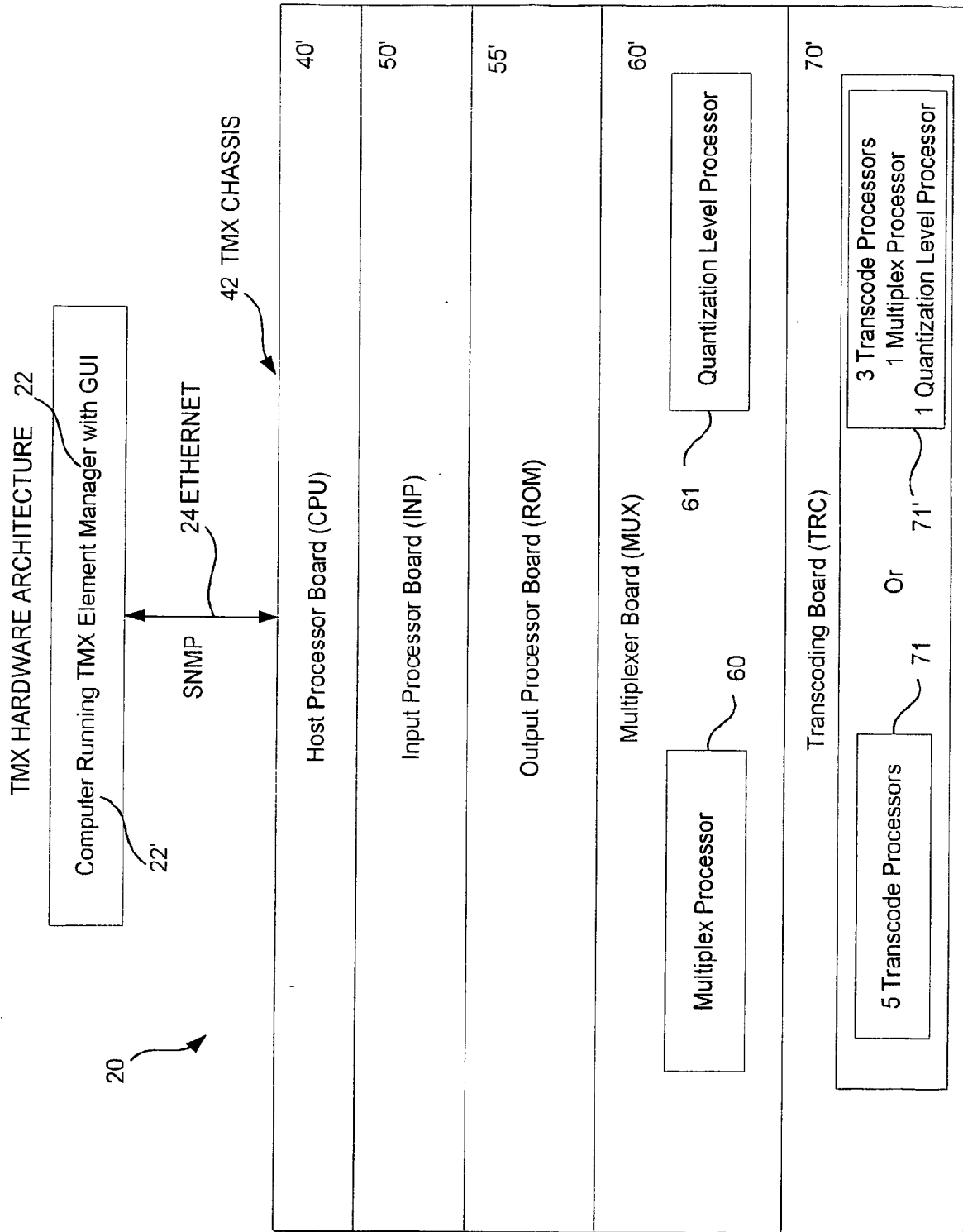


Figure 1a

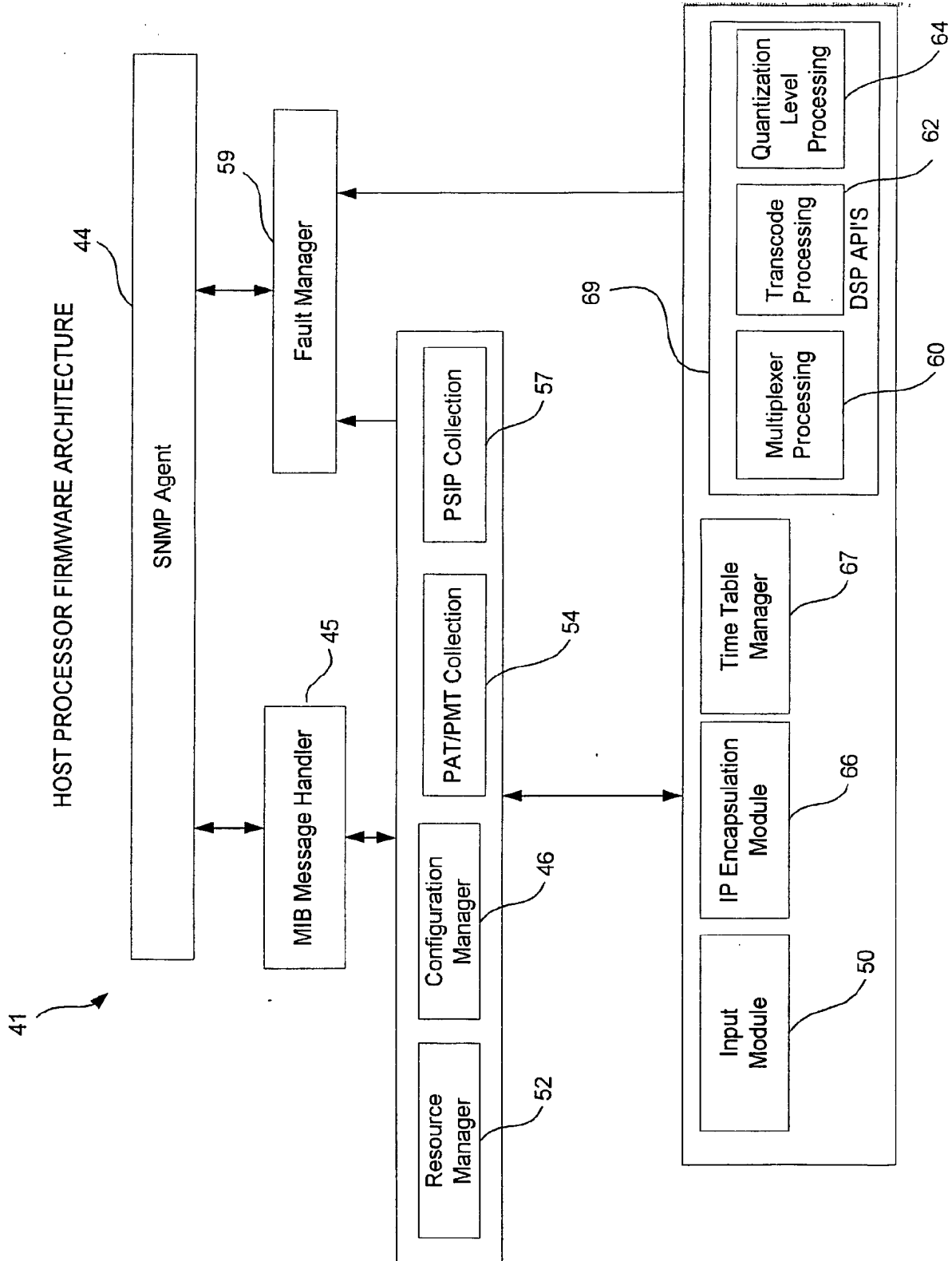


Figure 1b

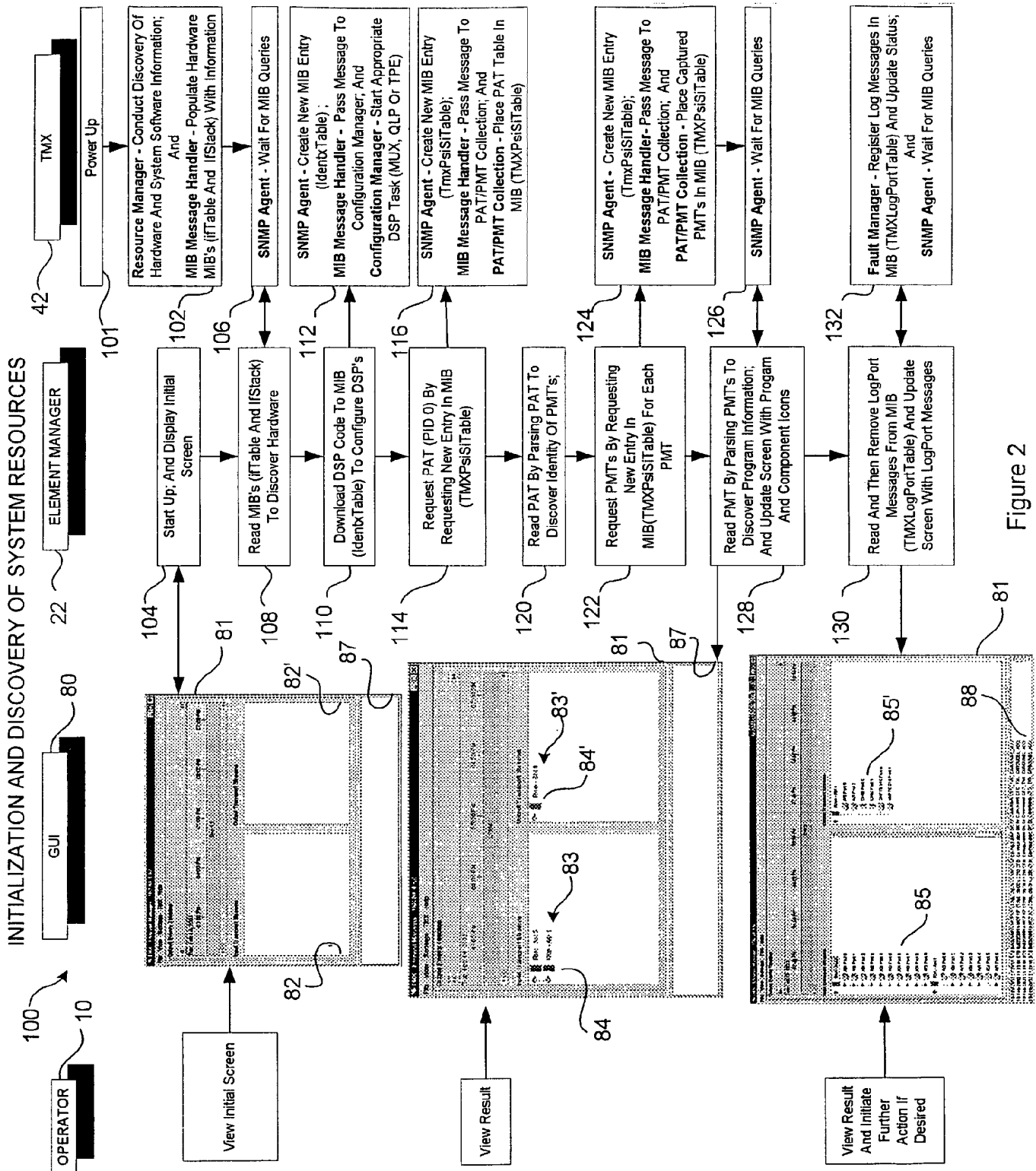


Figure 2

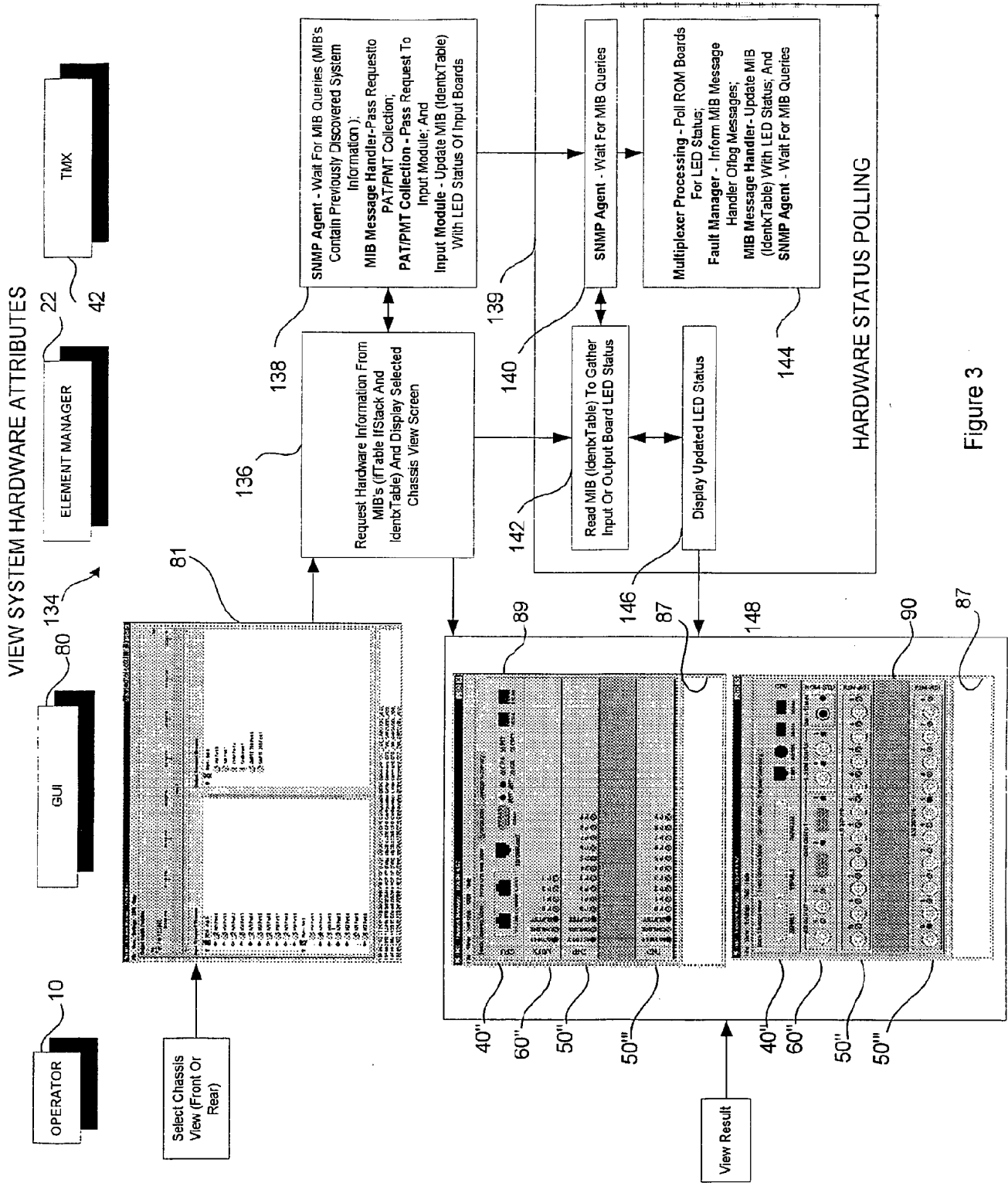
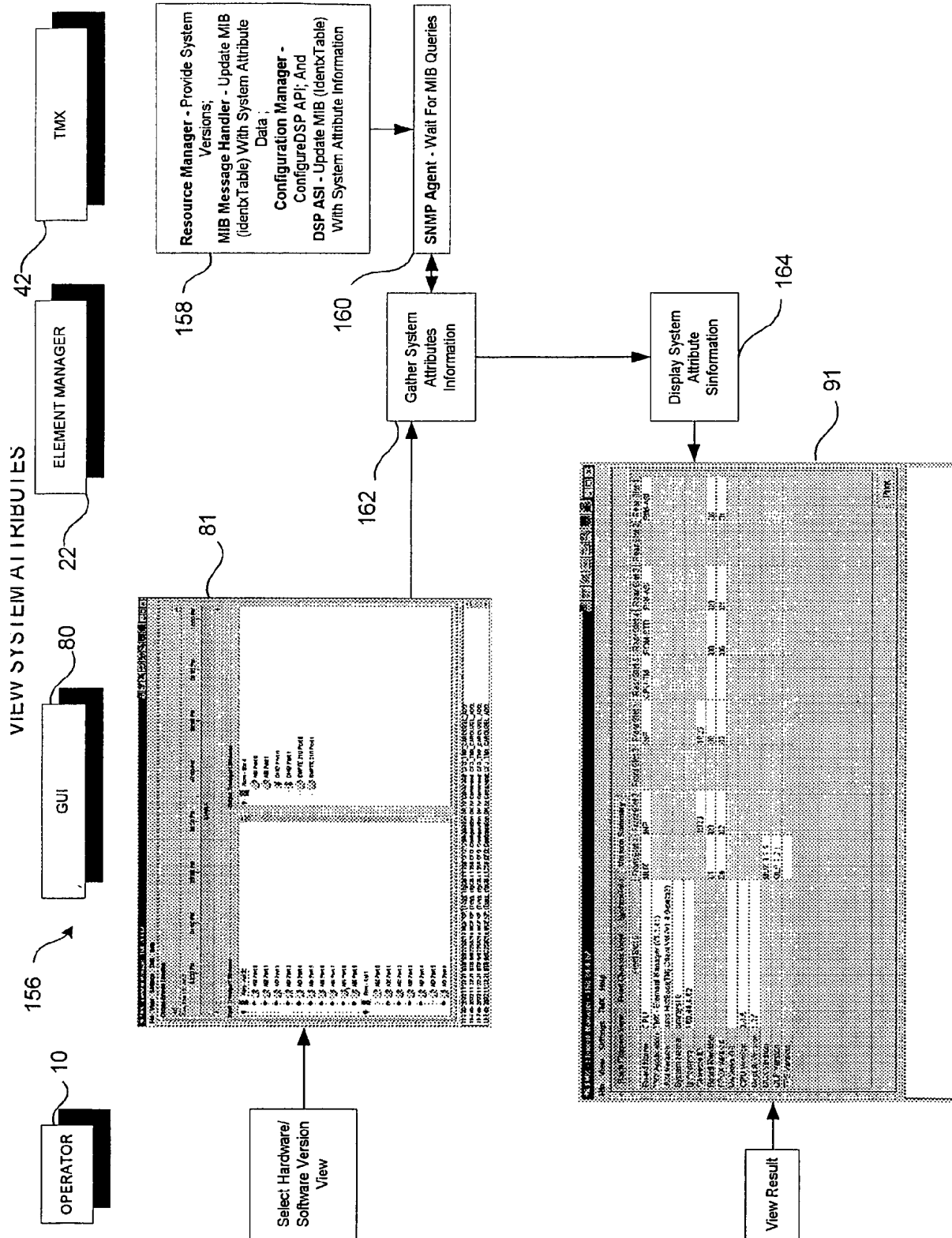


Figure 3



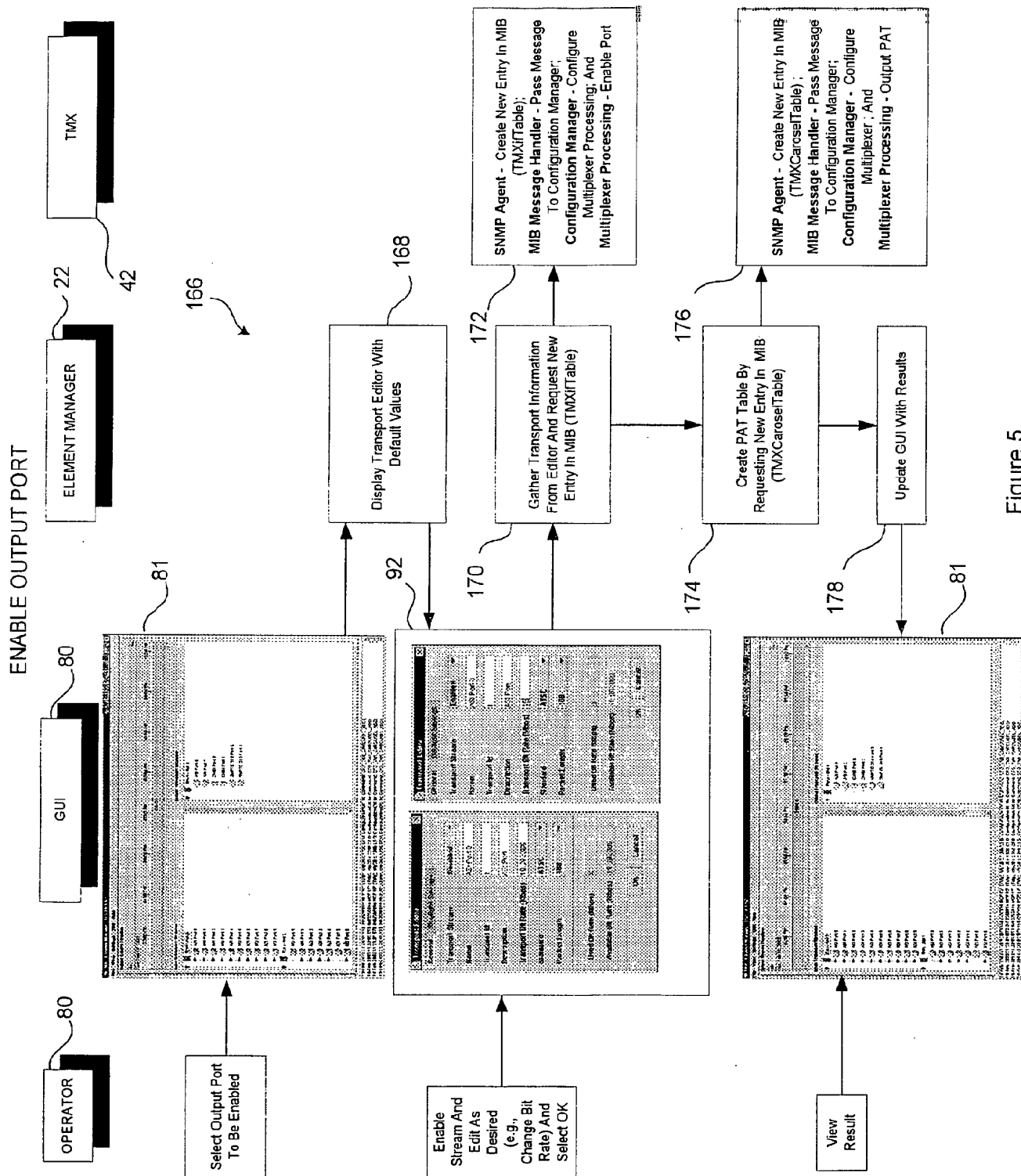
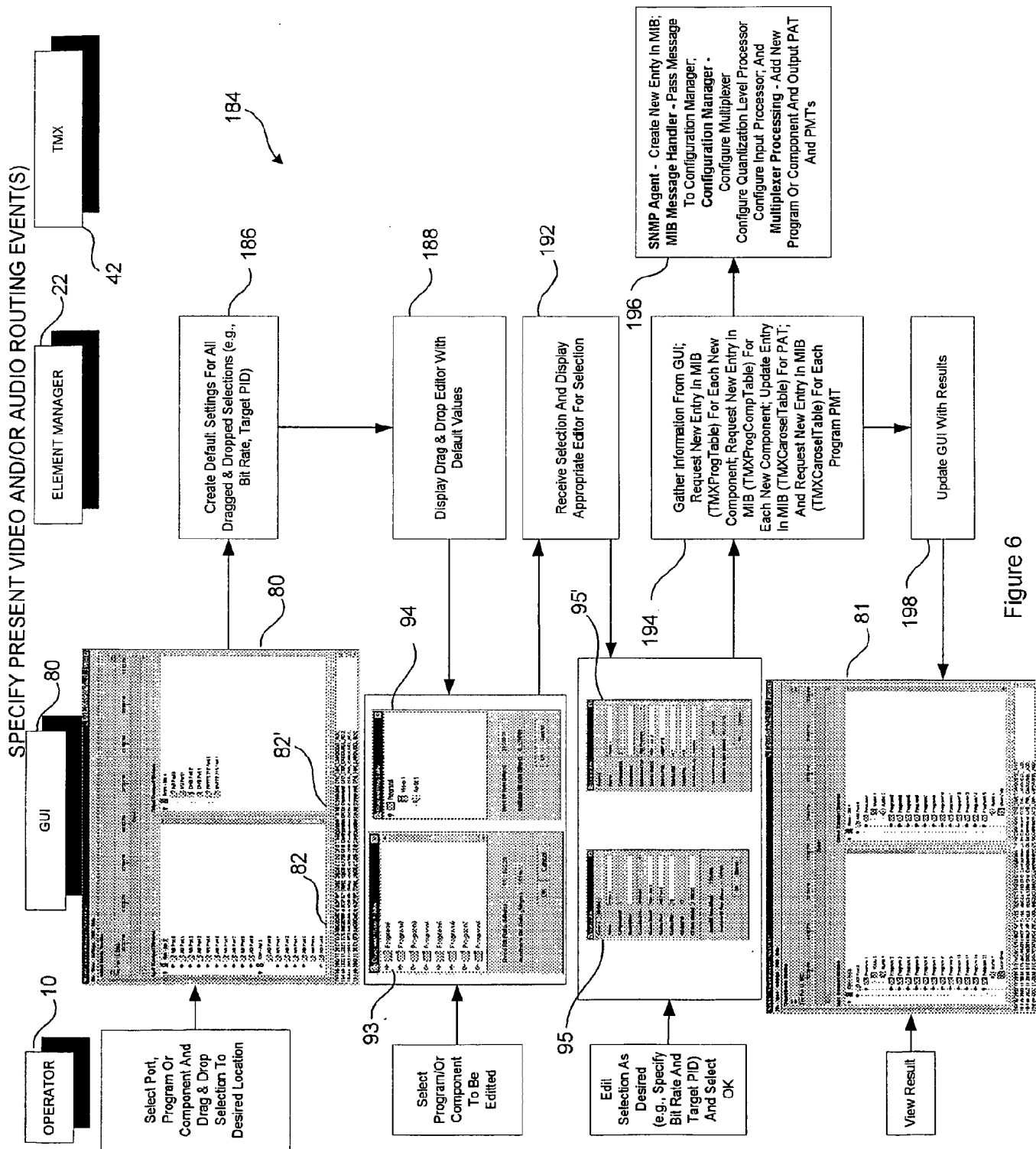


Figure 5

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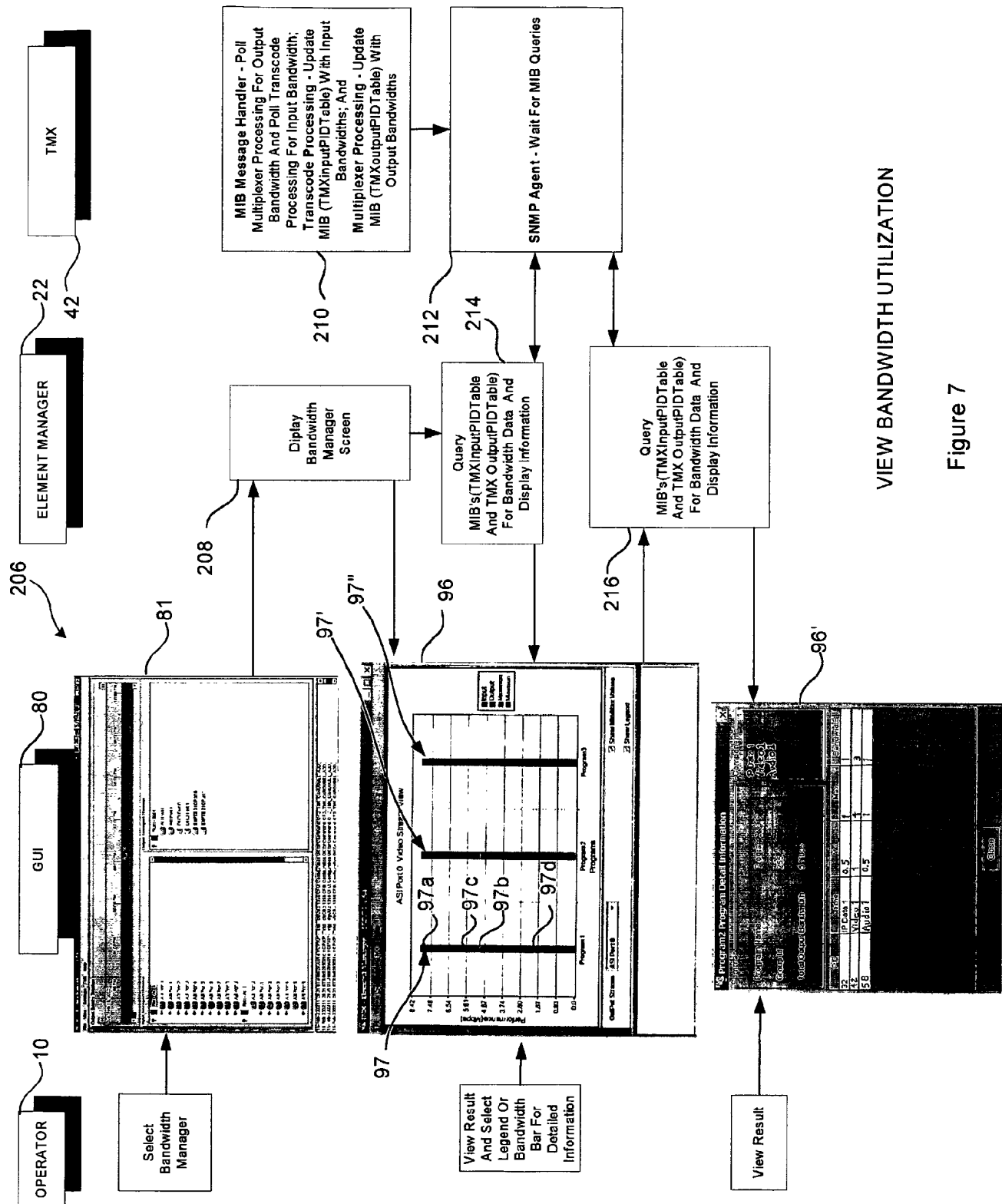


Figure 7

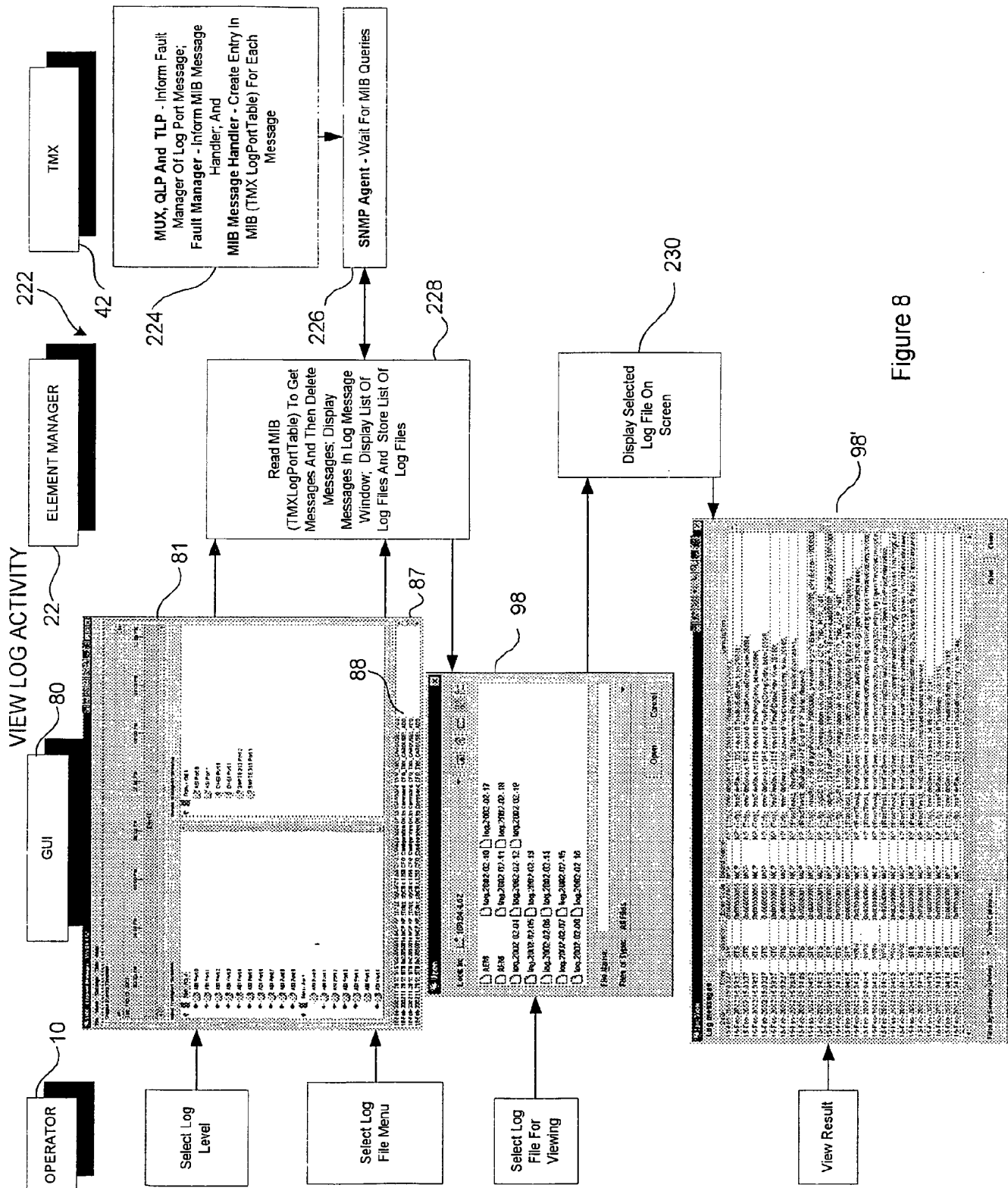


Figure 8

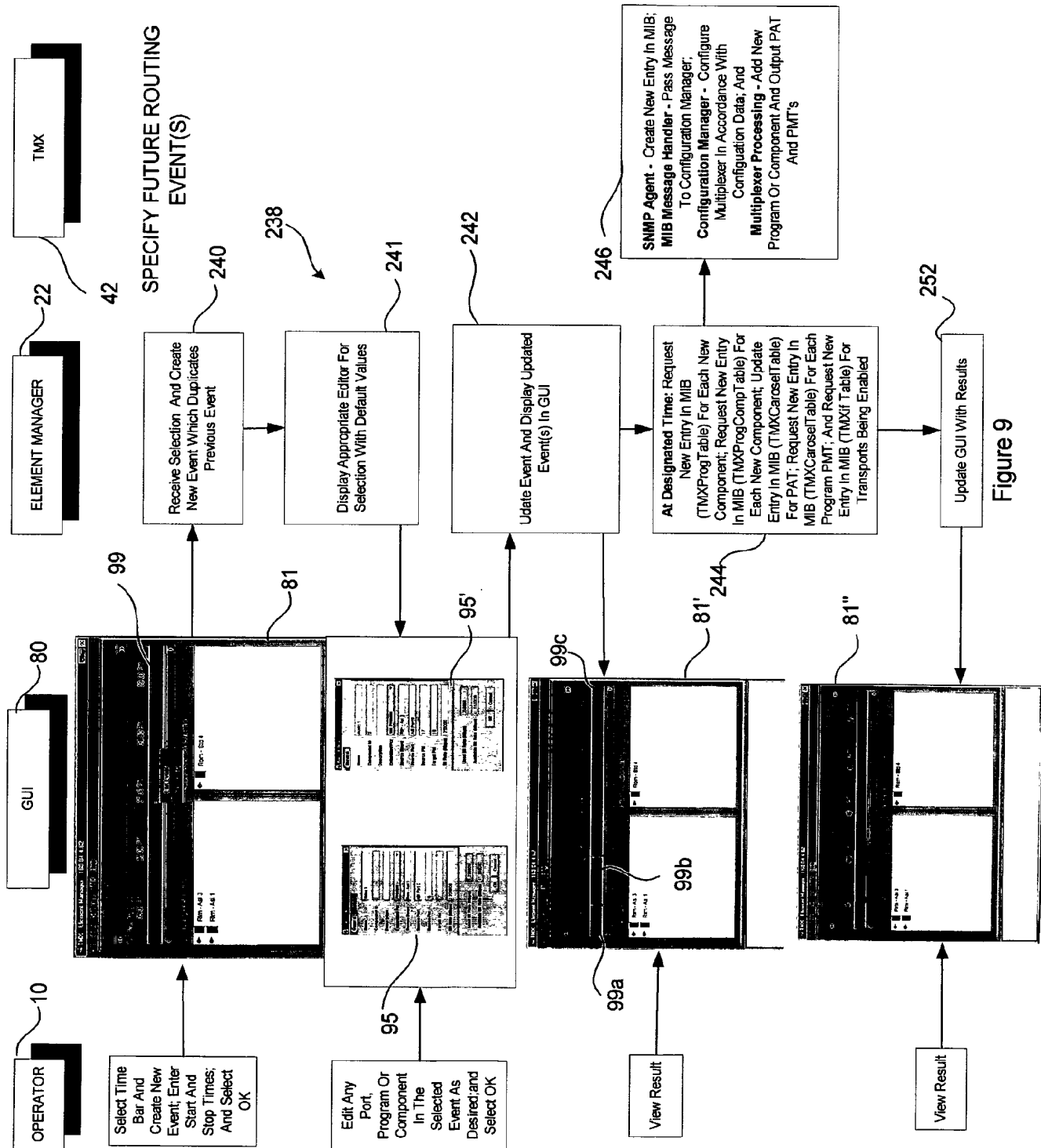
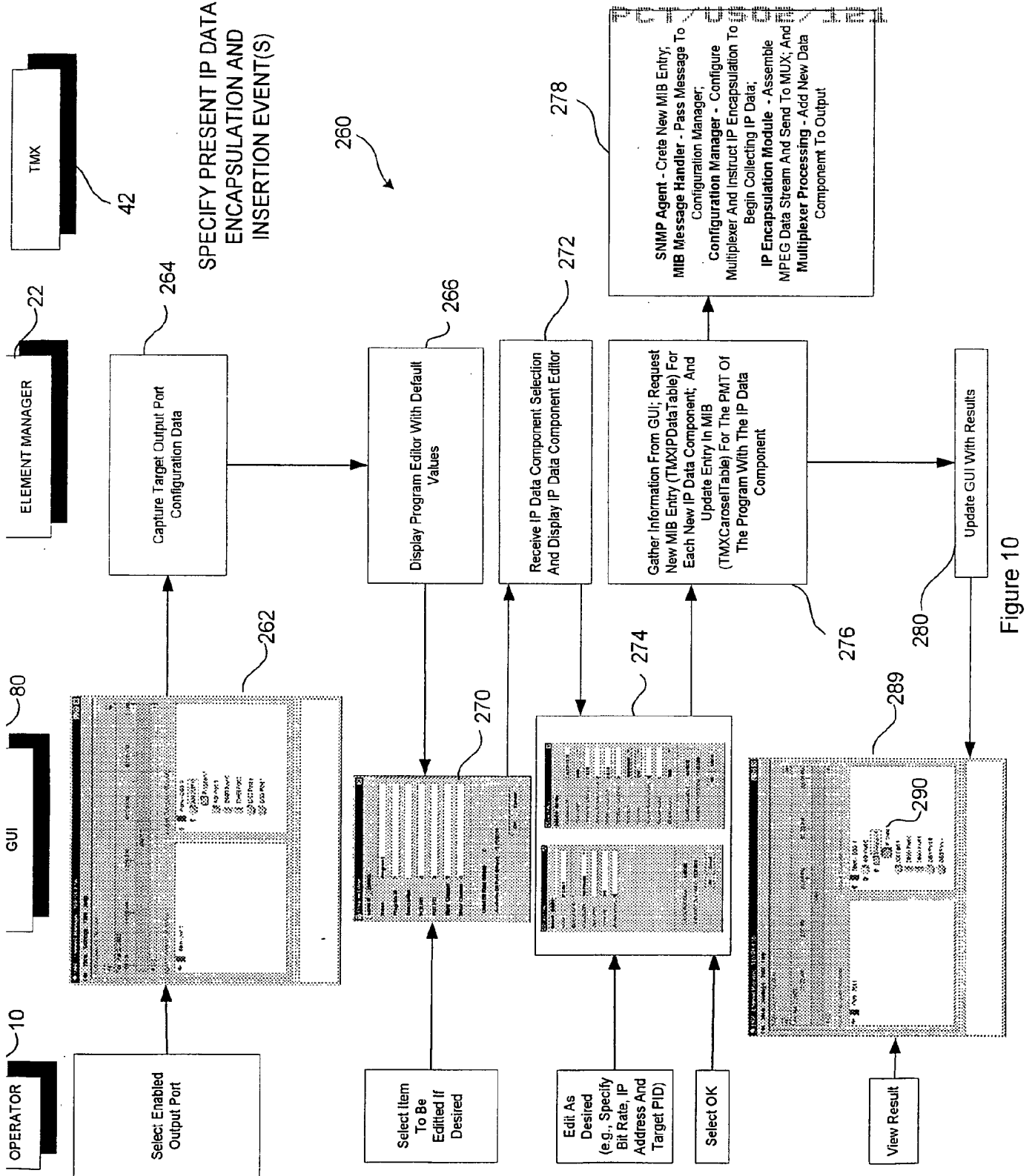


Figure 9



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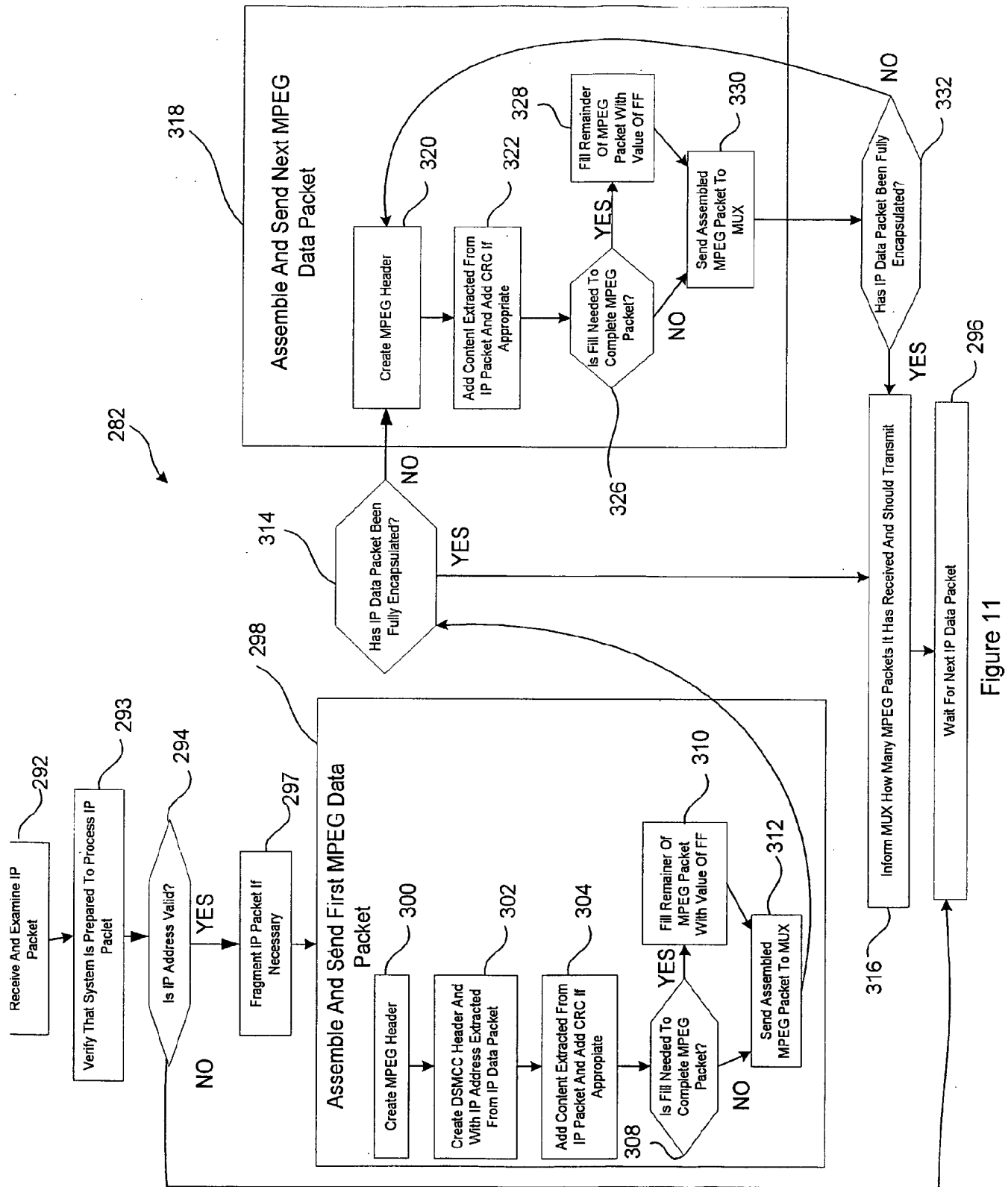


Figure 11